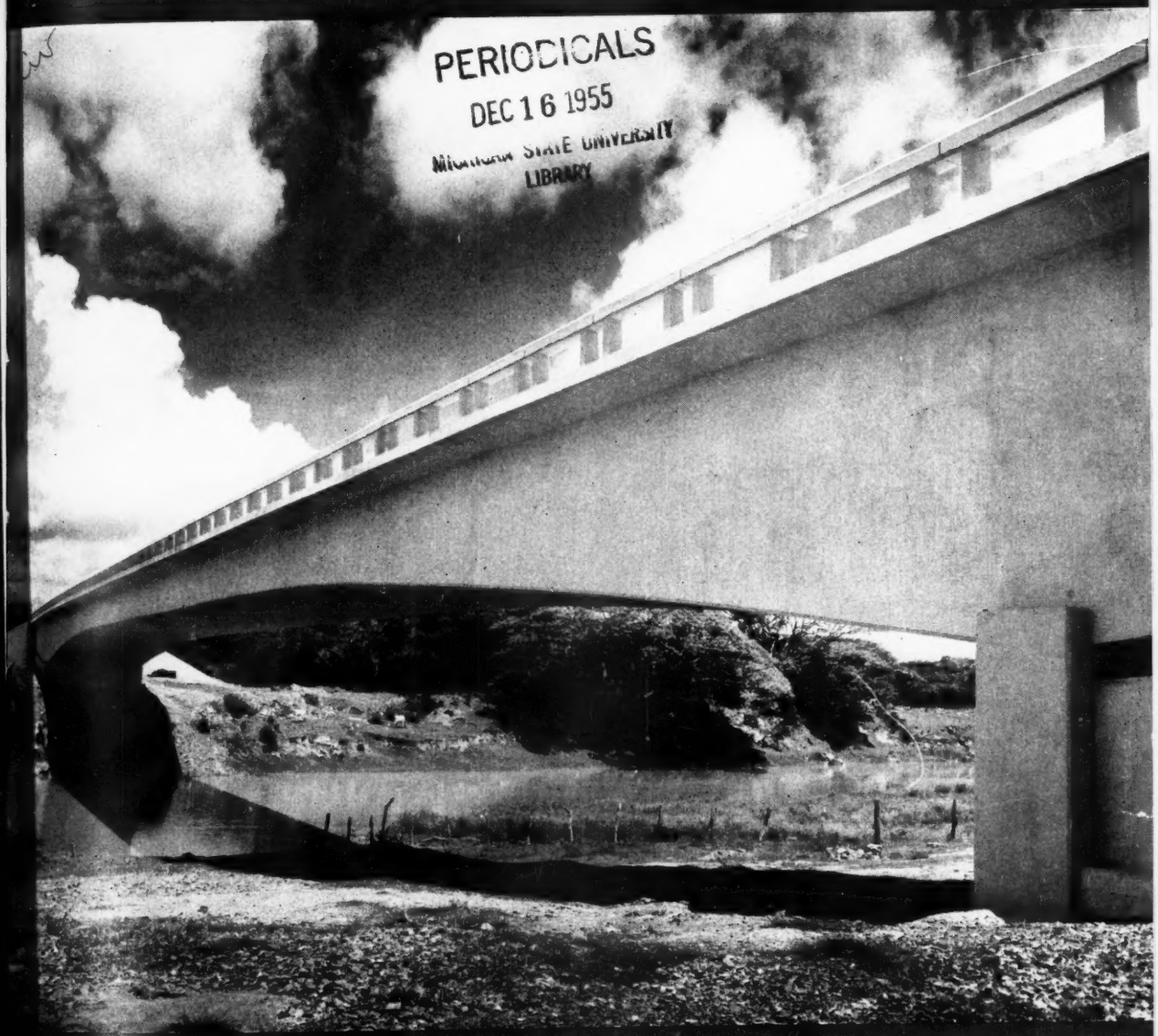
CIVIL ENGINEERING

DECEMBER 1955

THE MAGAZINE OF ENGINEERED CONSTRUCTION



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PROGRAM • DALLAS CONVENTION • FEBRUARY 13-17, 1956

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EDITORIAL & ADVERTISING DEPARTMENTS of ASCE Headquarters, 33 West 39th Street, New York 18, N.Y.

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Subscription Rates—Price 50 cents a copy. $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents, and postage to all other countries outside of the United States and possessions, $1.50 additional.

Member Audit Bureau of Circulations

43,800 copies of this issue printed

CIVIL ENGINEERING

DECEMBER 1955
VOL. 25 • NO. 12

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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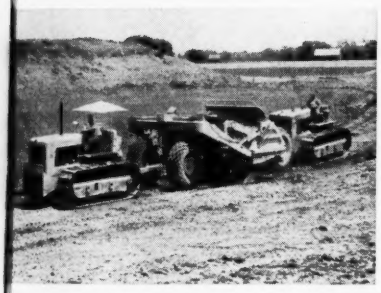
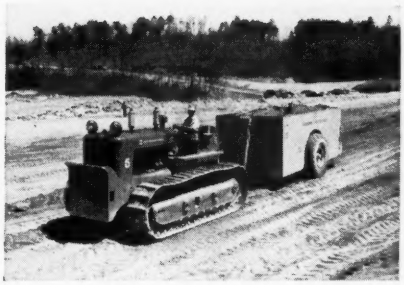




PAY OFF ACROSS THE COUNTRY

6 for J. D. Armstrong on Kansas Turnpike—Of their 9 TD-24's, this Ames (Iowa) contractor reports all have run 5,000 hours or more before needing any repair work. Six on 1.7-mile, million-yard Turnpike section near Emporia, are towing 50-ton rollers, pulling and push-loading scrapers. On hauls of 700 to 2500 ft., they account for 5,000 pay yds. per day.

2 for J. W. Moorman on Buford Dam, Georgia—These "24's", two of the five now owned by Moorman, push-loaded scrapers or pulled 50-ton rubber-tired rollers, 18 hours every day for 18 months. On compaction, they averaged 180,000 cubic yards weekly for the 200-ft.-high, 1630-ft.-long main dam. Moorman's other TD-24's are used to push-load scrapers, and pull or push belt loaders.

3 stripping overburden for Meyer Bros., Pennsylvania—"Proven crawlers," says Partner George Meyer of his TD-24's. "We've used our 3 for 3 years now. They have good balance plus unmatched push power." Right now, rigs are removing 30 feet of shale and clay to uncover a 30-inch vein of bituminous coal. The 2 TD-24's do 80% of the job; a large shovel, 20%.

NEWS OF ENGINEERS

Four Engineers Retire From State Service

The State of California is losing four of its top engineer executives through retirement. All are members of ASCE. Retiring are:

A. D. Edmonston, state engineer and chief of the Division of Water Resources, retired on November 1 after 31 years in state service. Formulation of the State Water Plan, including plans for the Central Valley Project, was under his direct charge. As state engineer since 1950, he has been engineer and secretary of the State Water Resources Board and executive officer of the Water Project Authority of California.

Thomas B. Waddell, assistant state engineer, retired on November 2 after 38 years in state service. Mr. Waddell's long tenure with the state included 15 years with the Division of Water Resources as supervising hydraulic engineer in charge of Central Valley Project studies and flood control and conservation investigations.

Gerald H. Jones, assistant state engineer, also retired on November 1 after more than 31 years of state service. His work has included over-all supervision of the safety of dams and operation and maintenance of the Sacramento River Flood Control Program.

Walter A. Douglass, senior highway engineer in the Bridge Department, retired on August 25, culminating a 31-year career in the Division of Highways.

Mason J. Young, Brigadier General, U.S. Army (ret.), formerly with the Corps of Engineers, recently joined the staff of Fay, Spofford & Thorndike in Boston, as assistant chief engineer on military construction.

Charles D. Curran, until recently administrator of the Task Force on Water Resources and Power of the new Hoover Commission, has opened consulting offices at 711 Fourteenth St., N.W., Washington 5, D.C. Before assuming his post with the Hoover Commission in 1953, Mr. Curran served as senior specialist on engineering and public works in the Legislative Reference Service of the Library of Congress.

Secretary of the Navy Charles S. Thomas congratulates Rear Admiral Robert H. Meade, CEC, U.S. Navy, after presenting him with his commission as Chief of the Bureau of Yards and Docks and of Navy Civil Engineers. The swearing-in ceremony took place in the Pentagon on November 8. Admiral Meade, a veteran of 26 years of Navy service and recently director of construction for the Navy's bases in Spain, succeeds the late Rear Admiral John P. Perry. Mrs. Meade looks on approvingly.

Daniel Larkin

Daniel J. Larkin has been appointed sales engineer at the Phillipsburg, N.J., sales office of the Warren Foundry & Pipe Corp. of New York, N.Y.

Thorndike Saville, president of Engineers Joint Council and dean of engineering at New York University, received the ASME's 75th Anniversary Medal at that society's Joint Honors Luncheon in Chicago on November 17. Dean Saville was awarded the medal "in appreciation of his friendly cooperation and in recognition of his outstanding leadership in the Engineers Joint Council and as its president." He has been on the N.Y.U. staff since 1932 and dean of engineering since 1936.

Frank A. Schilling, a general contractor, has retired as secretary and project manager of the Hayden Lee Corp., Los Angeles, Calif. Mr. Schilling is residing at 121 Via la Circula, Redondo Beach, Calif.

Louis J. Pignataro, member of the engineering faculty of Polytechnic Institute of Brooklyn, has been elected to the Board of Directors.

D. H. Redinger, retired engineer of Laguna Beach, Calif., has been honored by the Southern Edison Co., which has given his name to one of the power reservoirs he helped to build during more than thirty years in the service of the company. The 35,000-acre-ft Redinger Lake, formed by Dam No. 7, is part of the multi-million dollar Big Creek Project with which Mr. Redinger was associated from 1912 until his retirement in 1947. At the ceremonies naming the lake, the president of the company paid a tribute to Mr. Redinger's "character, engineering and managerial ability."

Billy T. Sumner has been made a member of the firm of Barge-Waggoner, Inc., Nashville, Tenn., civil engineering firm. Mr. Sumner was formerly resident engineer for Polk, Powell & Hudson in Nashville.

Lucien E. Harrison has resigned as city engineer of Huntington, W. Va., to enter private practice. Mr. Harrison was with the city for 18 years except for service with the Army Engineers during World War II. His headquarters will be at 703 Fifth Avenue, Huntington 1, and he will specialize in municipal engineering.

Lewis S. Harvey has joined Louis Berger & Associates of East Orange, N.J., and Harrisburg, Pa., as senior associate and chief engineer. Mr. Harvey was formerly chief highway engineer for J. K. Knoerle & Associates, general consultants to the Illinois Turnpike Commission.

Harvey J. Goetz has been appointed manager of Dorr-Oliver (India) Ltd. Mr. Goetz will assume his new post in Bombay about December 1. In addition to responsibility for administration and technical guidance of the company, he will initiate arrangements to manufacture Dorr-Oliver equipment locally in India.

Harvey Goetz

Allan C. deSoucy, construction management engineer for the U.S. Air Force, South Pacific Division, San Francisco, is one of several Air Force civilian employees who received pins for their years of government service at recent ceremonies in San Francisco. Mr. deSoucy, a resident of Daly City, Calif., has been an Air Force employee for 18 years.

Richard A. Haber has been named vice-president in the Contract Development Division of the Michael Baker, Jr., Inc., consulting engineering firm of Rochester, Pa. Mr. Haber was chief engineer of the Delaware Highway Department before joining Michael Baker, Jr., Inc., as a highway engineering specialist in 1953.

(*Continued on page 22*)

News of Engineers

(*Continued from page 19*)

Frank Kerekes, dean of the faculty, Michigan College of Mining and Technology, Houghton, has been nominated president of the American Concrete Institute. Dean Kerekes has been active in the ACI since 1938 and is currently serving a term as vice-president. He will assume the presidency during the annual convention of the ACI in February.

Frank L. Kerekes

Robert Talbot Knapp, professor of hydraulic engineering at California Institute of Technology, received the Melville Medal of the American Society of Mechanical Engineers at the organization's recent annual meeting in Chicago. The medal is given for the best original paper on any mechanical engineering subject, presented to the society for discussion and publication during the preceding year.

Willard D. Beattie, formerly associated with Hill & Ingman, consulting engineers of Seattle, Wash., has been appointed manager and chief engineer for the Southwest Suburban Sewer District, Seattle.

Marvin Kudroff and **Shuji Magota** have been named associates in the firm of Daniel, Mann, Johson & Mendenhall, Los Angeles Architects & Engineers. The firm states that this is the first time it has named any member of its organization to such a post.

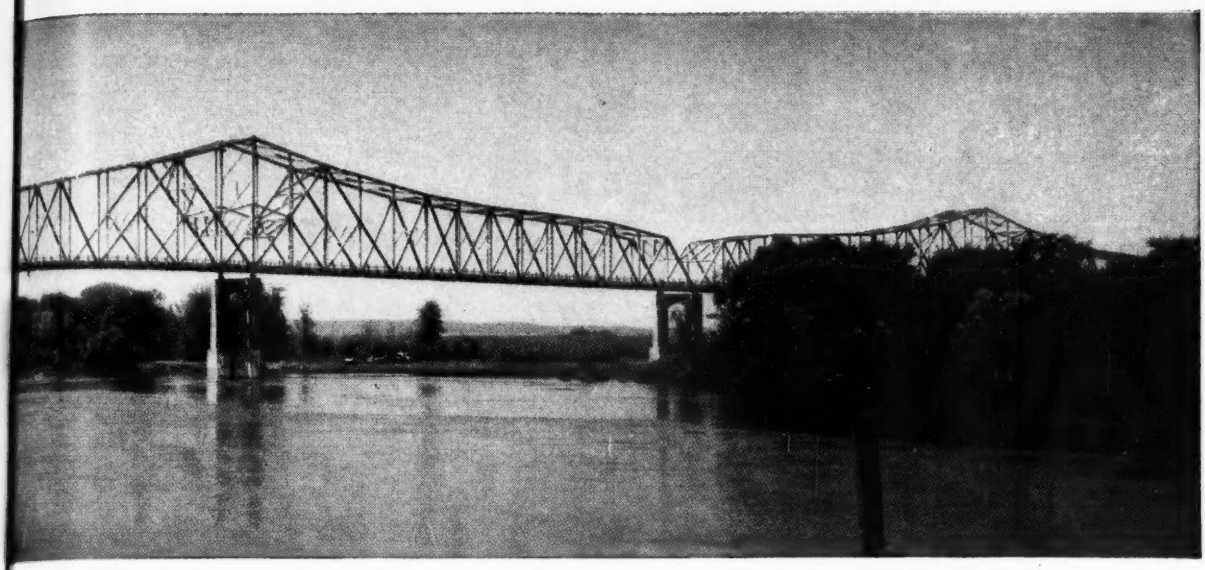
Theodor von Karman, chairman of the Scientific Advisory Board of the U.S. Air Force and Honorary Member of ASCE, has been awarded the Daniel Guggenheim Medal for 1955 for "long continued

T. von Karman

leadership in the development of aerodynamic theory and in its application to the practical problems of flight, in education in the aeronautical sciences, and in stimulating international cooperation in aeronautical research."

Benjamin F. Fairless, chairman of the Executive Advisory Committee, U.S. Steel Corp., has been selected as the 1955 recipient of the Award of Merit, presented annually by the American Institute of Consulting Engineers.

Daniel L. Croll, J.M. ASCE, (center), recipient of the Eighth Annual Lincoln Arc Welding Foundation's second Grand Prize of $1,000, hands a $500 check to Walter Langsam, (left), president of the University of Cincinnati, while Cornelius Wandmacher, M. ASCE, head of the civil engineering department, looks on. Mr. Croll won the prize for his design of a welded tubular-type transmission tower while a student at the university and member of the Student Chapter there. He graduated in 1955. The university receives half of the Lincoln prizes.



solved by switching to

USS High Strength Steel

Here's a case history that every bridge designer could profitably remember when designing his next bridge. It shows how *high strength* steel gave the engineers on this job an easy way out of a difficult situation, one that you too may face some day.

The original design of this recently completed bridge across the Illinois River at Beardstown, Ill., called for ASTM A7 structural carbon steel in the superstructure trusses, girders and floor system. Open-grid steel flooring was originally specified for the roadway.

However, after work on the bridge had started, it was decided to use a solid floor on the truss spans . . . concrete-filled road slabs that added approximately 39 lbs. per square foot, which meant a total of 864 tons dead load added to the truss superstructure.

Ordinarily such a change would have required a complete redesign of the superstructure as well as the foundations—but the latter were already built and therefore could not be strengthened. Here was a pretty dilemma.

The engineers found a simple and economical solution by switching to USS TRI-TEN (A-242) Steel which provides a minimum yield point 1.52 times that of structural carbon steel. By substituting TRI-TEN (A-242) Steel in the exact size and weight of the original carbon steel members affected by the increased road slab load, costly changes in connections were made unnecessary and the extra strength needed was amply provided.

550 tons of USS TRI-TEN (A-242) Steel were used in this switch-over to a stronger—and more durable—construction. Had carbon steel been used, it is estimated that 730 tons of steel would have been needed to obtain the strength required.

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USS

UNITED STATES STEEL

Non-ASCE Meetings

American Institute of Electrical Engineers. Winter general meeting at the Statler Hotel, New York, January 30 through February 3. Details from AIEE, 33 West 39th St., New York 18, N.Y.

American Road Builder's Association. Fifty-fourth annual convention at Municipal Auditorium, 1700 Washington Ave., Miami Beach, Fla., January 11-14. For information regarding hotels and program write to ARBA, World Center Building, Washington 6, D.C.

Eastern Snow Conference. Thirteenth annual meeting at Dartmouth College, Hanover, N.H., February 9 and 10. For information address the secretary, Dean B. Bogart, Box 948, Albany, N.Y.

Engineers Joint Council. Nuclear Engineering and Science Congress and Atomic Exposition (sponsored by the American Institute of Chemical Engineers and coordinated by EJC) in Cleveland, Ohio, December 12-16. Information from EJC, 29 West 39th St., New York 18, N.Y. . . Second annual General Assembly at the Hotel Statler, New York City, January 26 and 27. Details from EJC, 29 West 39th St., New York 18, N.Y.

Highway Research Board. Thirty-fifth annual meeting at the Sheraton-Park Hotel, Connecticut Ave. and Woodley Road, N.W., Washington 8, D.C., January 17 through 20. Information from Highway Research Board, National Research Council, 2101 Constitution Ave., N.W., Washington 25, D.C.

Society of Plastics Engineers, Inc. Twelfth annual National Technical Conference at the Hotel Statler, Cleveland, Ohio, January 18 through 20. Details from Mr. Frank Martin, General Chairman, the Hoover Co., North Canton, Ohio.

RECENT BOOKS

Verdichten von Beton mit Innenrüttlern und Rütteltischen-güterprüfung von Deckensteinen

Deutscher Ausschuss für Stahlbeton, Publication No. 116

Compaction of concrete by internal vibrators and by jarring tables is discussed from a practical standpoint, with results of tests under varying conditions. A further section of the publication is a report of tests on the quality of hollow concrete floor blocks. Reports on tests are presented by Kurt Walz. (Wilhelm Ernst und Sohn, Berlin, 1954. 34 pp., DM. 10.00.)

Das Hängende Dach

A comprehensive treatment, by Fred Otto, of the catenary cable-supported roof, which reviews developments in Europe and the U.S., discusses the underlying theory, and describes the design and construction of numerous examples of existing structures. There is a bibliography. (Available in U.S. from Wittenborn & Co., 38 East 57th St., New York 22. 160 pp., $10.50.)

Instruments for Measurement and Control

Nine chapters of this book, by Werner G. Holzbock, are devoted to descriptions of the operational characteristics and, in many cases, the structural details of instruments commonly used in industrial plants for measuring temperature, humidity, pressure, flow, and other process variables. Five chapters deal with various control devices—electric, pneumatic, hydraulic, etc.—and the last chapter briefly summarizes recent trends in the use of centralized control systems. (Reinhold Publishing Corporation, 430 Park Ave., New York 22, 1955. 371 pp., $10.00.)

An Introduction to the Theory of Aeroelasticity

The main body of this book, by Y. C. Fung, on the effect of aerodynamic forces on elastic bodies is in two parts. Chapters 2 to 11 cover the historical background, physical concepts, and principles of analysis of aeroelastic problems, including various problems in civil and mechanical engineering, flutter, transient loads, and gusts. Chapters 12 to 15 present the fundamentals of oscillating airfoil theory, and a brief summary of experimental results. Basic principles of aerodynamics, elasticity, and mechanical vibration are reviewed in the first chapter. (John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, 1955. 490 pp., $10.50.)

Korrosion—Dechema-Jahrestagung 1954

The twenty papers included in this volume, presented at a corrosion conference in 1954, cover a wide range. Sample topics are the following: corrosion inhibitors; protection by plastic coatings or wrappings; chemical treatment of water to reduce corrosion; cathodic protection of underground and underwater installations; stress-corrosion phenomena; electrochemical aspects of corrosion; and special corrosion problems of various metals under diverse circumstances. The papers are sponsored by DECHEMA Deutsche Gesellschaft für chemisches Apparatewesen. (Verlag Chemie, Weinheim, Germany, 1955. 127 pp., DM 9.50.)

Proceedings of the American Power Conference
Volume XVII, 1955

As in previous years the papers in these proceedings emphasize the practical rather than the theoretical view and range from the technical to the economic and social aspects of power generation, transmission, and distribution. Grouped by sessions—general interest, nuclear energy, mechanical, water technology, and electrical—the individual papers deal with such subjects as scientific manpower, sodium graphite reactor power plants, power plant stacks under wind loading, small gas turbines, the St. Lawrence Seaway, computing devices, and many others. (Illinois Institute of Technology, Technology Center, Chicago 16, Ill., 1955. 722 pp., $6.00.)

Research Reactors

This book, by the United States Atomic Energy Commission, gives descriptions of three types of light-water-moderated reactors (pool, solution, and materials-testing), and of three other types: hydro-carbon-moderated, heavy-water-moderated, and graphite-moderated. Information given for each type includes general design features, core design and fuel handling, cooling system (where applicable), control and instrumentation, shielding, experimental facilities, and operating characteristics. The book was prepared originally for the International Conference on Peaceful Uses of Atomic Energy. (McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, 1955. 442 pp., $6.50.)

Technical Publications

This is a guide specifically intended to aid engineers and other technicians in the preparation of engineering manuals, instructional leaflets, reports, and other types of technical publications. Written by C. Baker, it deals with the selection of a style suited to the user, the use of clear language, methods of presentation, the use of illustrations, methods of reproduction, and preparation of copy for printing. Also briefly discussed are the use of technical literature in the aircraft industry, questionnaires, and specification writing. (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, 1955. 302 pp., $6.00.)

The Technology of Cement and Concrete
Volume I: Concrete Materials

About half of this volume for engineers, contractors, and students covers the properties and manufacture of portland cement; pozzolanic and other hydraulic cements; and the classification and evaluation of admixtures and additions. The remainder of the volume is devoted to the geology and petrography of aggregates, their sampling, testing, and processing, and the effects of their properties on concrete. The study—by Robert F. Blanks and Henry L. Kennedy—will be completed with a second volume covering the mixing, properties, and uses of concrete. (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, 1955. 422 pp., $11.00.)

Design of Prestressed Concrete Structures

A systematic coverage, by T. Y. Lin, of fundamentals intended to make present knowledge of prestressed concrete construction more widely available to engineers. Subjects discussed include the analysis and design of sections for flexure; shear, bond, and bearing; beam deflections and layouts; reinforcements; continuous beams; slabs; tension and compression members; circular prestressing; and allowable stresses and load factors. Although the book deals essentially with design, substantial space is devoted to materials, methods for prestressing, and economic factors. (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, 1955. 456 pp., $11.50.)

Principles of Industrial Waste Treatment

The greater part of this book, by E. Fred Gurnham, for practicing engineers and students is a discussion of operations and processes used to treat wastes before discharging them into natural streams or municipal sewers: sedimentation, filtration, heat transfer operations, and various chemical and biological treatments. Pollutional effects and criteria for evaluating pollution are also discussed, and the last chapter gives brief descriptions of some process industries that have major disposal problems. (John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1955. 399 pp., $9.50.)

Advanced Mathematics for Engineers

This book by H. W. Reddick and F. H. Miller is intended for the reader with a thorough training in engineering mathematics through calculus. Beginning with ordinary differential equations, the book takes up in order, hyperbolic functions; elliptic integrals; infinite series; Fourier series; gamma, Bessel, and Legendre functions; partial derivatives and partial differential equations; vector analysis; probability; functions of a complex variable; and operational calculus. Problems relating to civil, electrical, chemical, and mechanical engineering are given with each principal topic. The third edition is prepared by F. H. Miller. (John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N.Y., 1955. 548 pp., $6.50.)

(*Continued on page 106*)

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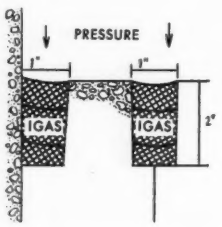
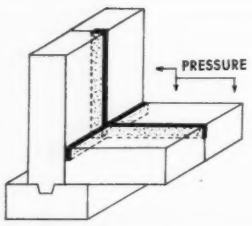
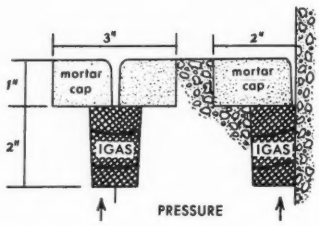


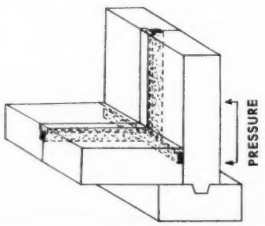


Water Reservoirs
Swimming Pools
Tanks
Parking Decks

TYPE B—Back Pressure



Basements
Tunnels
Retaining Walls



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do you know that

Revision of the Code of Ethics is proposed? The Board of Direction has adopted the recommendation of the Committee on Professional Practice to amend the controversial Article 4 of the Code of Ethics, dealing with "bidding on a price basis" (November issue, page 69). For the information of the membership, to whom the amendment will go for ratification, the Committee's statement is given in the "Society News" section of this issue.

Atomic energy promises power unlimited? Though still not competitive with fossil fuels, atomic energy is regarded by power authorities as one great hope for keeping pace with future energy requirements. This important new power source is analyzed in its effect on the country's economy in a timely article in this issue (page 36).

Many of the Hoover Commission recommendations are being put into effect? The Executive Branch has already taken action on 143 of the recommendations that do not require Congressional action. So says Clarence Francis, national chairman of the Citizens Committee for the Hoover Report. Special Research Memorandum No. 4 of the Citizens Committee, discussing the report, is available from the Committee, 1300 Wyatt Bldg., Washington 5, D. C.

A new method of water analysis promises better protection against germ warfare? Four Public Health Service scientists have just received a research award for developing a faster and more accurate method of analyzing the bacteriological content of water. Through their method, which involves the use of a membrane filter technique, it is possible to incubate, count, and identify the bacteria from a sample of water in as little as 16 hours compared with the 48 to 96 hours normally required. Recipients of the award are Dr. Paul W. Kabler, Harold F. Clark, Edwin E. Geldreich, and Harold L. Jeter, all of the Robert A. Taft Sanitary Engineering Center at Cincinnati.

The value of the Society's Group Disability Insurance Plan has been reaffirmed by the Board? At its recent meeting in New York, the Board of Direction heard the report of a special task committee assigned to review the Plan, then endorsed it "as a proper and valuable service to members" and urged wider participation in it. This year—sixth anniversary of the Plan—several new benefits have been made available to members (August issue, page 69, and October issue, page 124).

Public announcement of the results of the WASHO road tests was made at the Annual Convention? The Convention paper describing the results of the Idaho tests to determine what kind of roads we should build to stand up under today's traffic load, is scheduled for the January issue. The test took three years and cost $900,000.

Builders can now measure the strength of lumber without cutting into it? By means of a newly developed electronic device that can send concentrated ultrasonic waves through a piece of wood, the Timber Engineering Company expects to be able to study grain structure and irregularities that determine its strength.

A board for certification of sanitary engineers has been set up? To certify the professional qualification of sanitary engineers in public health and other assignments, papers of incorporation have been completed and signed for formation of an American Sanitary Engineering Intersociety Board. The office of the Board and its Certification Committee will be at ASCE Headquarters, with Frank Elder as secretary. More about this important step in the January issue.

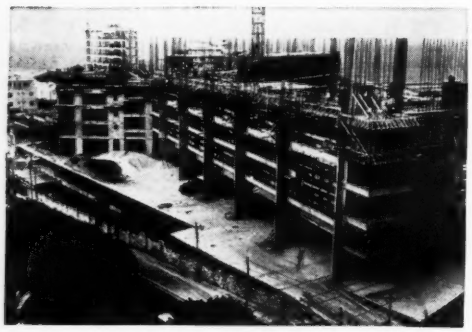
The United States leads the world in nuclear units? This country has 29 nuclear reactors out of a total of 42 known to exist throughout the world, the Atomic Industrial Forum reports. In addition to the 29 reactors here, there are five in Great Britain, two in France, two in Canada, and one each in Norway, Russia, Sweden, and Switzerland (the latter built by the U.S. for the recent United Nations Atomic Energy Conference). Of the 20 additional reactors under construction, nine are in the United States.

Construction next year is expected to top the 1955 record? This is the forecast that comes out of Washington. The Departments of Commerce and Labor see new construction expenditures for 1956 reaching a breathtaking total of $44 billion, 5 percent above the $42 billion peak indicated for 1955. They predict, also, that construction costs will continue to rise moderately, and that increased plant capacity and rising productivity will prevent all but minor material shortages.

Trafficwise, December 24 is the most dangerous day of the year? With statistics showing that traffic deaths are at their peak on that day, the National Safety Council designated December 1 Safe Driving Day and urged special caution all through the month. The 1954 traffic toll was 36,000 deaths and 1,250,000 injuries in 560,000,000,000 miles traveled. Cost of it all was $4,400,000,000.

HIGH AND MIGHTY

Havana Builds World's Tallest Concrete Apartment Building



"17 y M" COOPERATIVE APARTMENT BUILDING
Vedado, Havana, Cuba

Owner:
FOMENTO DE OBRAS Y CONSTRUCCIONES, S.A. (FOCSA)

Architects:
ERNESTO GÓMEZ SAMPERA, MARTÍN DOMÍNGUEZ,
BARTOLOMÉ BESTARD, MANUEL PADRÓN

Structural Engineers:
LUIS SAENZ, E. R. CANCIO, IGNACIO MARTÍN

Contractor: PROYECTOS OBRAS Y CONSTRUCCIONES, S.A.

● Nearing completion in Havana's Vedado section is one of the world's outstanding buildings—the tallest concrete apartment house, rising 39 stories, a total of 402 ft. above its footings.

Floors of this high and mighty structure are two-way reinforced concrete slabs. Walls instead of columns support the building's full weight, serve as partitions between apartments and as wind bracing, in a fire-safe, rigid, monolithic structure built to resist winds of hurricane force. The cellular structure provided the architects with ideal clear floor areas.

Framing in concrete saved almost a million pesos, as compared with alternative methods, again emphasizing the economies inherent in reinforced concrete.

With 30 floors of apartments selling at an average price of $20,000 per apartment, and income from rental space on the other floors, the owners will recoup their investment of 6-million pesos (1 peso equals 1 dollar) when 80% of the apartments are sold.

Cuba's designers have a way with concrete, as is well exemplified by this dramatic structure, in which, when completed, a total of over 110,000 bbls. of cement produced by Lone Star's Cuban subsidiary, La Compañia Cubana de Cemento Portland, will have been used.

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LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 18 MODERN MILLS, 141,600,000 SACKS ANNUAL CAPACITY

CIRCULAR SHELL DOME cast on earth mound

FRED J. FRICKE, A.M. ASCE, Consulting Engineer, Albuquerque, N. Mex.

An unusual construction program is being followed in building the new 6,000-seat Civic Auditorium of the City of Albuquerque, N. Mex. The program consists of first excavating and placing all circumferential columns, then casting a concrete circular-shell roof dome on temporary earth fill, winding the exterior ring beam with stressed high-tension wire, and finally excavating for interior construction.

This auditorium is the first building of a series to be constructed on a hillside site of about 20 acres selected to serve as the city's new Civic Center. Numerous other buildings are planned for the future.

The auditorium structure is a compromise between a theater type and an arena type. Draperies supported by tracks will serve as staging and back drops to accommodate theatrical and certain other types of small-scale performances. For a

Footings and columns are being placed in excavation surrounding mound on which shell dome will be poured.

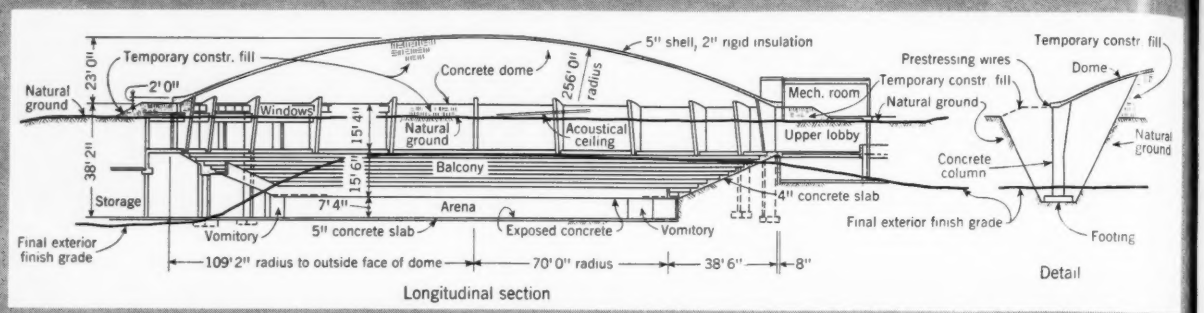


FIG. 1. Albuquerque Civic Auditorium will seat 3,500 in balcony of arena-type structure. Shell dome will be cast on temporary fill, which will be excavated after outer ring of shell has been post-stressed by winding with high-tension wire. Detail section shows column and footing arrangement.

Because site required considerable leveling, it was found feasible to utilize temporary construction fill as form for dome roof. Contractor elected to pour footings and columns first, and this work is seen nearing completion. Next, mound will be carefully shaped, and barrier of soil cement or other material will be placed to serve as form for dome.

large-scale performance such as a circus, 3,500 people can be seated in the balcony area.

The site requires considerable initial leveling. Because of this it became apparent that a temporary construction fill could be used to form the under side of a circular dome roof. The final selection of the building site on the 20-acre tract was made to best suit the landscaping and fill requirements of the lower part of the tract, weighed against the economic use of as little temporary construction fill as possible to form the under side of the dome. The springing line of the dome was set at approximately 4 ft above present grade. See Fig. 1.

It was proposed to cast the concrete roof shell on the temporary fill, by making the earth shape conform to that of the under side of the dome. The shell will be 5 in. thick and 218 ft 4 in. in diameter, and will be thickened at the outer edge to 24 in. to form an outer ring. When the shell and ring concrete reach a strength of 2,500 psi or better, high-strength wire, No. 8 gage, will be wound around the ring approximately 650 times at an applied stress of 145,000 psi to form a post-tensioned ring beam.

The ring beam itself is reinforced as a compression column to withstand the induced high-tensile wire load. It is not expected that the roof dead-load will be fully counteracted by the post-stressed wire load until all excavation beneath the dome has been completed. The wire is to be given an application of rich mortar at the time of placing, and eventually covered with approximately 8 in. of concrete or gunite to protect it from any danger of corrosion due to moisture. To protect the dome from temperature changes, roofing material and 2 in. of a rigid type of insulation will be applied.

The original design was based on the idea that the shell dome would be poured, and the stressed wire placed, before any of the 22 circumferential footings and columns were poured. However, the general contractor elected to excavate and place these footings and columns before pouring the dome. This sequence, the contractor felt, would eliminate any damage caused by slippage of earth embankment.

Once all 22 columns, footings, and the roof have been placed, final interior and exterior excavation and construction will be carried out. Since the roof shell will be poured and finished about December 15, 1955, winter excavation and construction progress can be made within the roofed structure without delay from inclement weather.

Concrete will not be poured directly on the earth mound, but on a barrier of soil cement or other approved material. An allowance of about $\frac{1}{2}$ in. for thermal expansion over a range of 70 deg is allowed for the total diameter of the dome. The dome concrete will have aggregate of $1\frac{1}{2}$-in. maximum size, and the least possible paste content to attain a 3,750-psi strength. This mixture will also provide for a maximum of $\frac{1}{2}$-in. initial setup contraction in the dome concrete. Contraction due to loading of the ring beam with stressed wire proves to be of no consequence.

Total area of the completed building will be about 70,000 sq ft.

The general contract for this building was awarded to Lembke, Clough & King on August 23, 1955, at a bid price of $1,010,229. Completion is scheduled for July 1956.

Architects for the project are Ferguson-Stevens & Associates, Albuquerque, N. Mex. Fred J. Fricke, A.M.ASCE, served as consulting structural engineer.

Who wants a civil engineer?

D. LEE NARVER, M. ASCE, Chairman of the Board, Holmes & Narver, Inc., Los Angeles, Calif.

Two statements paraphrased from recently published articles may surprise many in the profession; they certainly merit discussion. These statements are:

1. Both undergraduate and graduate students in civil engineering have fewer opportunities to secure financial assistance than do students in other branches of the profession.

2. It has been traditional to expect the civil engineering college graduate to earn his initial keep in surveying and drafting.

Our firm, not primarily a civil engineering group, recently offered two engineering scholarships, one in the East, one in the West. We specified that the awards were open to qualified people in several fields of engineering, but we listed civil engineering first. Why? Our firm embraces among its employees all fields of engineering contributing to the construction of industrial facilities, and in addition has been for seven years under contract to the Atomic Energy Commission at the Pacific Proving Grounds. We find approximately 60 percent of our work requires civil engineering.

It is probable that the designation "civil engineer" needs to be redefined even to engineers. Originally, the term "engineer" referred only to one who built military works. The term "civil engineer" was next used to identify one concerned with purely civilian activity, but at first it embraced the total function of the engineer, which is to use power and materials to the advantage of man. The intense specialization of the recent past produced, out of the original concept of civil engineering, new names such as electrical and mechanical. But if there ever was a time when the engineer was generally a lone consultant in an individual effort, that day is gone.

As with other professions, the engineer and the builder have been inclined to specialize, impelled in recent decades by the increasing complexity of the American industrial evolution. Not only have processes and machines grown more complex and plants bigger, technical and scientific progress has produced such a body of information that a man usually has been able to keep up to date in only one field. Also, the increasingly detailed and ever more rigid participation of state and local government in coding, inspection, licensing and granting of permits has required a virtual specialist in each field to assure compliance with the law.

A construction project formerly required a succession of individual skills, separately applied. For example, the architect had to be well along with his work before the electrical or the mechanical engineer did his part, and the plans had to be complete before the builder broke ground. If in that day we lost sight of the civil engineer, then I say again, that day is gone.

With the approach of World War II, and its large-scale and urgent construction programs, this sequence approach was too slow and lacked coordination. Management contracts were awarded to competent technical people to organize the necessary specialists into groups. There rapidly arose two new developments: the integrated technical service organization, and the system approach to a major development problem. Lone research men began working in groups. Traditionally individualistic scientists banded together, submitting themselves to management and applying to the common objective the system approach rather than the scattered individual one. Engineering groups offering a complete service became established. Combined architectural design, engineering, and construction under one management responsibility became more common.

In this climate, the traditional boundaries of engineering became less rigid. Our firm required qualified engineers to be oriented in formerly undefined fields, such as industrial site selection, community planning, investigations and reports, water resource analysis, long-range master planning, executive or administrative engineering, project engineering, construction control, estimating and specification writing, construction techniques, precision horizontal and vertical control of structures associated with the testing of guided missiles or nuclear weapons, and the investigation of soil bearing and soil characteristics for concentrated or critical industrial loads. We rediscovered that there is no better technical preparation for these special opportunities than civil engineering.

The new opportunities are here to stay. To the young engineer, these opportunities may indeed become necessities. Since he seldom can open his own office immediately after graduation, he must, like the doctor or lawyer, gain experience and stature by a period of professional association. During this period he may find that what he thought to be his major inclination is being altered by two influences: (1) His job may lead him, by his function in the group, into specialties not elective but required. (2) He may find within himself aptitudes for special engineering work which he could not, before graduation, anticipate. How successfully he adapts himself to these unavoidable influences will depend in large part on how broad and fundamental was his engineering training.

In the system approach to the fast-moving technology of the industrial age, the mechanical engineer, the electrical engineer and all the rest have an undisputed and irreplaceable position in the segments of the system. But no engineer is better equipped to embrace the system as a whole than the civil engineer. Why? Virtually by definition. And if the premise which opened this article is true, the definition might well be restated.

A bulletin of the University of Cincinnati says that, "In the broadest sense the primary function of the civil engineer is to adapt the physical geography of the earth to the needs of man. He conceives, builds, maintains, and operates the structures and works of modern civilization."

The State of California Civil and Professional Engineers Act, Chapter 1709, Statues of 1951, Article 3, Section 6731, on licensing engineers, says:

"6731. Civil Engineering embraces the following studies or activities in connection with fixed works for irrigation, drainage, water power, water supply, flood control, inland waterways, harbors, municipal improvements, railroads, highways, tunnels, airports and airways, purification of water, sewerage,

refuse disposal, foundations, framed and homogeneous structures, buildings or bridges:

"(*a*) The economics of, the use and design of, materials of construction and the determination of their physical qualities.

"(*b*) The supervision of the construction of engineering structures.

"(*c*) The investigation of the laws, phenomena and forces of nature.

"(*d*) Appraisals or valuations.

"(*e*) The preparation and/or submission of designs, plans, and specifications and engineering reports."

An example of civil engineering considered as the fundamental field is found in Section 6736 of the same Act, which states:

"6736. No person shall use the title, structural engineer, unless he is a registered civil engineer in this State and, furthermore, unless he has been found qualified as a structural engineer according to the rules and regulations established therefor by the board."

It seems clear that the high school graduate who is certain he wants to be an engineer, but is uncertain as to what kind of an engineer, should by all means be first a civil engineer.

Scholarship awards have little purpose if not to perpetuate in able people the profession of engineering, that the technical heritage of our culture may be carried forward and augmented. If so, civil engineering candidates should have top support. We feel that in the civil pattern the engineer can more readily find himself, and have a better springboard from which to specialize when he does find himself—and further, that in this broad field he will have the necessary time to do so.

Few engineering undergraduates can conceive of the vast areas of opportunity in engineering. How can they realize, for example, what is now suspected, that no longer does science limit the available nuclear power, for good or evil? The frontier of its use has become an engineering problem. To the engineer of imagination, the challenge of limitless fields to conquer lies in conceiving the necessary materials and adapting the works of man to these imponderable new forces.

The works of man that we engineered and the materials we adapted in my generation to the uses of war and peace are already obsolete. The long strides of youth and imagination are needed to catch up with an acceleration of discovery and progress almost incalculable even to those of us near enough to industrial America to see it clearly. This is the case for vigorous support of engineering education. If it makes sense, then it also makes a case for vigorous support of *civil* engineering.

What is the future for nu

NELSON P. JACKSON, Colonel, USAF (Retired);

The greatest "chain reaction" of 1954 went almost unnoted by the press. That "chain reaction" was the record birth in the United States of four million, sixty thousand babies. This fact leads to the observation of two important economic realities:

1. Our population will exceed 200 million by 1975.
2. Our need for electric energy by 1975 will be approximately three times today's kilowatt-hour consumption.

Against this backdrop, let us examine a question which is important to your business and to mine. "Where does atomic energy fit into the economic structure as we know it today, and as we project it for the next two decades?"

Let us start with the fundamentals. As is well known, energy comes from the sun. Some arrived within the year and furnishes us with food. Much arrived in our lifetime and contributes to our shelter and other construction. Much more arrived many thousands of years ago and built up the supply of fossil fuels from which we obtain vast quantities of heat and electric energy.

The importance of this energy is obvious. It is no accident that the United States with only 7 percent of the world's population produces 50 percent of the world's manufactured goods. More than any other factor, abundant energy is the cornerstone of our tremendous productivity and of our standard of living. Stuart Chase has said that "nowhere on the horizon is there a saturation point for power. Its future is limitless. It not only marches to ever greater quantitative output, but also transforms the entire economic structure as it goes."

The United States and a considerable part of the Free World have been living high on the accumulated capital energy in the tremendous reserves of coal, oil, and gas. Rates of extraction of these non-renewable fossil fuels have been great.

If we are to continue to improve our standard of living, while keeping up with demands placed on our economy by growing population and consequent needs, it is essential that all sources of energy be developed. Our surest hope lies in nuclear fuels. Only if we take immediate action to put atomic energy to use can tomorrow's economy continue to grow without serious dislocation.

Although we can be sure that there will be major applications of nuclear energy for transportation, for heating and in chemical processing, yet there is little question but that the greatest application will be in the production of electric power.

By 1975 it is estimated that nearly one-half of the power stations then under construction will use nuclear fuels. In Fig. 1 is shown the projected growth of nuclear plants coming on the line, starting at about 2 percent of all new power plants between 1960 and 1965 and growing to 14 percent by 1970 and 44 percent by 1975. We would not be at all surprised to see this figure reach 65 percent by 1980.

Now, what is going to happen to conventional power plants using fossil fuels? Some may assume that, with the advent of nuclear fuel, coal and oil will be forced out of the picture. Nothing could be further from the truth. While we are confident that nuclear energy will show phenomenal growth during the next 25 years, at the same time many millions of kilowatts of new capacity in fossil-fueled stations will be required to support the growth of our economy, as shown in Fig. 2.

In Fig. 3 are the forecast totals of generating capability in the United States. In terms of total generating capacity, the growth of nuclear power stations will, of necessity, start slowly. To care for the power needs of our country, it will be necessary to increase the conventionally fueled generating capacity from 120 million kw in 1960 to 300 million kw by 1975 and 350 million kw in 1980.

The three points of cardinal importance illustrated by these three figures are, first, that the future power needs of our country are phenomenal; second,

nuclear power plants?

Manager, Washington Office, General Electric Company, Washington, D.C.

that the greatest growth in generating capacity in the next twenty-five years will still lie in fossil-fueled plants; and third, that in this same period of twenty-five years, the construction of new nuclear-fueled power stations is forecast to equal the total generating capacity which has been built up in our country up to the year 1955.

Now let us look at some investment figures, and start off by comparing, in Table I, the plant investment per kilowatt for a representative coal-fired plant with that for a boiling-water reactor which we believe can be achieved within the next five to ten years. It will be noted that the investment in physical plant is substantially larger for the nuclear station and that, similarly, the engineering and startup charges are greater. This brings up the fact that nuclear power plants call for a greater contribution of investment dollars than do coal- or oil-fired plants. In fact, the fixed charges for a nuclear plant are approximately 50 percent greater than those for a coal plant. Similarly, operating costs are two-tenths of a mill greater per kilowatt-hour.

TABLE I. Plant investments compared

	Boiling-Water Reactor Plant	Coal Plant
Physical plant	$195	$140
Engineering	15	11
Start-up	14	7
Land	2	2
Total plant investment per kw	$226	$160

TABLE II. Power costs compared

	Boiling-Water Reactor Plant	Coal Plant
Fixed charges	4.5	3.0
Operating costs	0.7	0.5
Fuel	1.7	3.4*
Total power cost, mills per kwhr	6.9	6.9

*Coal at 35 cents per million Btu.

The payoff lies in power costs, estimated in Table II, for a plant of 300,000-kw capacity, in mills per kilowatt-hour. It is seen that the real saving lies in fuel costs. For the coal plant, we have shown costs which are not yet obtainable but which we are fully confident can be realized and will be bettered.

The cost situation is summarized in Fig. 4. Today's costs are not competitive with conventional steam plants in the heavily populated centers of this country but, with plant investment costs which can be foreseen and with the lower nuclear-fuel costs which we are on the way to developing, electric power generated from nuclear energy can and will be fully competitive with power costs from conventional steam stations. Since there will be a severe drain on the supplies of fossil fuels in the next twenty-five years, these fuels cannot be expected to become lower in cost. Nuclear-fuel development is in its infancy. We have every confidence that the fuel costs shown here will be met or bettered.

A closing thought summarizes my opinion of the present situation in nuclear energy. In the fourth act of Julius Caesar, where Cassius advocates a course of "rest, defense, and nimbleness," Brutus replies:

There is a tide in the affairs of men,
Which, taken at the flood, leads on to fortune;
Omitted, all the voyage of their life
Is bount in shallows and in miseries.
On such a full sea are we now afloat;
And we must take the current when it serves,
Or lose our ventures.

The nuclear tide is nearing its flood. Men of courage and conviction in science, in industry, and in finance are faced with opportunities unequaled in their business lives. This new field of atomic energy has been, is now, and will continue to be a challenge to America's research, engineering, and manufacturing skill.

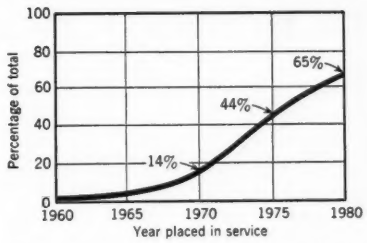


FIG. 1. Forecast for generating capacity of new plants coming on the line 1960–1980 indicates that by 1980 about 65 percent will derive power from nuclear fuels.

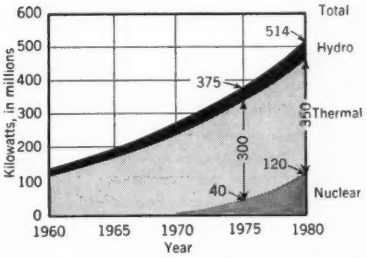


FIG. 2. Forecasted total capability of all generating plants in service 1960–1980, shows relative percentages of nuclear, thermal, and hydro in kilowatts. Thus in 1975, estimate indicates there will be 40 million kw of installed nuclear capacity, 300 million kw of thermal capacity, and 35 million kw of hydroelectric capacity.

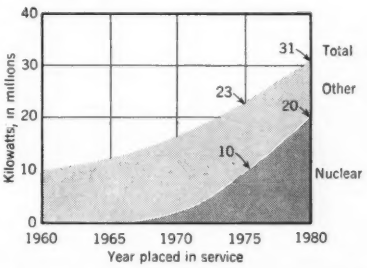


FIG. 3. Forecast for generating capacity of new plants placed in service 1960–1980, in millions of kilowatts, indicates that by 1980 nearly two-thirds of total new capacity coming on the line will be derived from nuclear fuels.

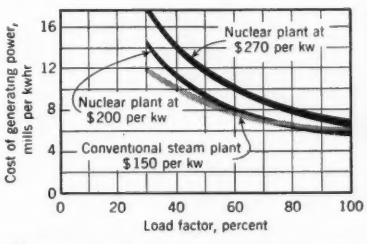
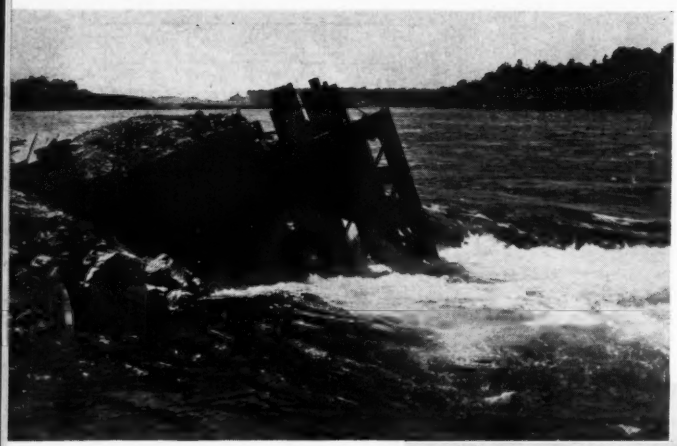


FIG. 4. Cost of power from nuclear plants is compared with that from conventional steam plants. Nuclear fuel costs are considered to be approximately 2.0 mills per kwhr for both the $200- and the $270-per-kw plant.

Contractor finds St.

A. S. WIKSTROM, A. M. ASCE

A. S. Wikstrom, Inc., Skaneateles, N. Y.



When rock of 5- to 7-ton size was washed out of end of south dike by force of current, steel basket was built of 12 × 12 H-piles braced with angle irons and partially lined with sheetpiling after placing basket, to hold rock with which basket was filled. Note 3- to 4-ft drop in water surface at end of dike. Here water depth is 40 ft and stream velocity about 18 mph. At times velocity reached 20 mph before pier was completed.

→ In view looking upstream, south pier is seen completed at left and north cofferdam under construction at right, protected by dike extending out from Barnhart Island. Immediately upstream is treacherous Long Sault Rapids, through which entire 400,000 cfs flow of St. Lawrence River passes. Cofferdam for Long Sault Dam is in right background.

Work on south pier is in progress inside cofferdam. Just to left, crawler crane stands on dike spur built on sunken icebreaker. End of dike, held by H-pile basket, extends out into river at extreme left. Barnhart Island is in background.

High river velocities, winter ice and other difficulties required marked changes in construction concepts during building of the substructure for the new Barnhart Island Bridge across the St. Lawrence. Currents up to 20 mph swept 7-ton rocks from the protective dike into the pier site, and heavy ice flows persistently overcame whatever defensive systems were erected to safeguard construction. Although we had previously worked on many river structures, we found our past experience only a primer for the work on the St. Lawrence.

The Barnhart Island Bridge across the St. Lawrence River at Massena, N. Y., will be the first permanent structure in the St. Lawrence Power Project to be completed. It will provide access to the site of the Barnhart Island Powerhouse, which lies between Barnhart Island and the Canadian shore. To provide temporary access to the island for the 1955 construction season, a

St. Lawrence bridge substructure no picnic

floating bridge was built about 3 miles downstream during the winter and spring of 1954–1955. (See article by Richard Q. Praeger and Sidney M. Johnson, in CIVIL ENGINEERING for November 1955, p. 53.) The arrival of ice in the river will make it necessary to remove this floating bridge by January 1956, and the permanent bridge must be completed by that time.

The site of the permanent bridge was selected near the west end of Barnhart Island at a point where the river narrows between the island and the mainland. This location provides a solid rock foundation reasonably close to the surface.

Designed by Praeger & Kavanagh, the bridge has two 50 × 80-ft rectangular piers approximately 225 ft offshore, founded on rock 41 ft below river level on the south side and 36 ft below on the north side. On the south side very little overburden was encountered, whereas on the north side the overburden was approximately 12 ft deep. In addition to the two piers, there are two gravity-type abutments located about 60 ft back from the shore line. The south abutment stands on steel H-beam bearing piles driven into glacial till; the north pier is placed directly on the glacial till. The steel superstructure is a continuous through truss with a center span of 508 ft and two 283-ft anchor spans, requiring approximately 5,000 tons of structural steel. The structure is designed to carry both vehicular and rail traffic. A flatcar with a 125-ton load was the significant design load.

The contract for the substructure was let in the latter part of October 1954. Because of the necessity for completion of the entire bridge in about 14 months, the contractor was required to work through the winter. The bridge design was based on the meager information on foundation conditions in the river that was available prior to the bidding date. Rock elevations were determined by seismograph readings made in the area, and the overburden soundings were taken by fathometer in the general area by the Ontario Hydro-Electric Commission. Soundings in the river could only be taken successfully by fathometer as a conventional sounding line would be swept downstream by the velocity of the current.

At the bridge site, the river is 950 ft wide. When we started work, all the flow of the St. Lawrence was passing through this channel as the Canadian cofferdam contractor had already closed off the Sheek Island Channel which runs around the north side of Barnhart Island. At the site the fast current runs close to the south shore as it sweeps around the west end of Barnhart Island from International Rapids at velocities of 16 to 18 miles an hour. Along the north shore the velocity is about half this amount. On both sides the river banks rise steeply to an elevation of 35 to 40 ft above the river.

Before taking bids on the bridge substructure, the Power Authority had awarded a drilling contract to another contractor, who built a floating drill platform to take test cores at the two pier sites. In the latter part of November 1954, when three borings had been made at the site of the north pier and one boring at the south pier, the drill barge broke loose from its cable moorings and was swept downstream. Since the drilling contractor had already had difficulties in moving this drill barge to the site and in holding it there, this occurrence led to the decision that it would be futile to continue the boring program, and the final design of the piers had to stand on the information then available. The borings that had been taken indicated a 39-ft depth of water at the south pier, with 2 ft of overburden over the rock; and a 24-ft depth at the north pier, with rock located 36 ft below the water surface. Since rock was 11 ft deeper on the north side, and 7 ft deeper on the south side than originally contemplated, the design was revised from a 72-ft circular pier to a rectangular pier 50 by 80 ft. This revision decreased by 11 ft the dike protection required and somewhat reduced the amount of concrete. Adequate foundation information for the abutment had previously been obtained from core drills.

Several vexing problems confronted the foundation contractor:

1. The time available to complete the piers was short, as steel erection was to begin on June 15, 1955.
2. The intense cold and ice in the river materially decreased the output of the men and made river work difficult and costly.
3. High velocities made it necessary to provide a stilling pond in which to work on the piers.
4. Normal high water due to ice jams in February and March made the contractor's work area particularly vulnerable to damage during that period.
5. The intended method of pier construction had to be revised at the last minute because accurate foundation information was not available until six weeks after the contract award.

To provide relatively quiet water, our plan called for building a stone dike running out 250 ft into the river at right angles to the shore, 140 ft upstream from the center line of the pier. This dike construction was started in the first part of December, using stone from a quarry opened up by the contractor 14 miles from the job site. It was anticipated that this dike would raise the river level immediately upstream about 6 ft and divert the current 40 or 50 ft from the end of the dike. These conclusions were the result of studies on the Ontario Hydro-Power Commission's model of the St. Lawrence River at Islington, Ontario. This model was most helpful in arriving at conclusions as to how the river would behave under the conditions we were creating at the bridge site.

I must add here that the accuracy of any conclusions drawn from a model depend on the accuracy of the information that is provided for building the model and on how close the model adheres to actual conditions. Because of the extremely fast and deep water at the bridge site, accurate soundings of the river bottom were not obtained. Consequently the river conditions in the model did not accurately reflect the true conditions. From the model study, we definitely decided that the proper way to build the dike was at right angles to the shore and about 140 ft upstream from the pier.

During the early part of December 1954, good progress was made in extending the dike out 135 ft to a point where the river bottom dropped off rapidly.

When a depth of 30 ft was reached, the end of the dike began to wash severely, and it was decided to use larger stone. From results on other work where obstructions had been placed in fast water, it was concluded that stones of 5- to 7-ton size could be successfully dumped in the river and would hold. We therefore selected stone of this size from our quarry and later moved into a commercial quarry where the stone broke larger. By continued dumping of big stones, we were able to progress approximately 50 ft further out into the river. However, as the water depth increased to 38 ft, it took longer for the stone to sink to the bottom and the large stones washed downstream.

During one night a 14-ft length of dike containing the large stones washed away. As we were still 60 or 70 ft from the point where we felt the dike should end to give us quiet water in the pier area, some new method of holding the rock was necessary. The new plan was to build a large basket of steel bearing piles and welded wire mesh, which would be light enough to be handled by an 80-ton crane and yet strong enough to hold the rock. Such a steel basket was built about 35 ft long and varying from zero to 40 ft high to follow the slope of the outshore end of the existing rock dike. This basket was made with as little frontal area as possible, and anchored upstream to two 10-ton concrete deadmen, embedded in the shore, by two 1 $^1/_8$-in. cables attached to both the upper and the lower part of the basket. These anchor cables were reeved back by a six-part line to a D-8 dozer with a winch, which stood on shore and enabled us to hold the offshore end of the basket in final position when set by the crane. A second D-8 dozer with a cable attached to the basket held the inshore end. After several attempts this basket was placed, even though light ice was running in the river, and was putting considerable pressure on the upstream face by clogging the wire mesh.

As soon as the basket was set, it was filled with rock, and it successfully accomplished its purpose. It was deemed advisable not to go out another 25 ft into water 40 ft deep, as the current was now running several miles per hour faster around the end of the dike, and the difficulties that would be encountered in going out this additional distance looked almost insurmountable. At the contractor's request, Praeger & Kavanagh, the engineers, permitted the entire bridge to be moved 25 ft to the south, thus bringing the south pier 25 ft nearer the shore. The foundation problems on the north side were relatively easy, and were not adversely affected by this movement. This relocation also had the advantage of making it possible to proceed immediately with work on the south pier.

It is interesting at this point to note that the theoretical pressures on the steel basket computed by the usual hydraulic formulas did not develop, and it was fortunate that this was the case. We ran readings on the steel cables with a tensiometer as a check on the cable stresses. The lower stresses can be accounted for by the turbulence created by the wire mesh, which dissipated the full force of the water.

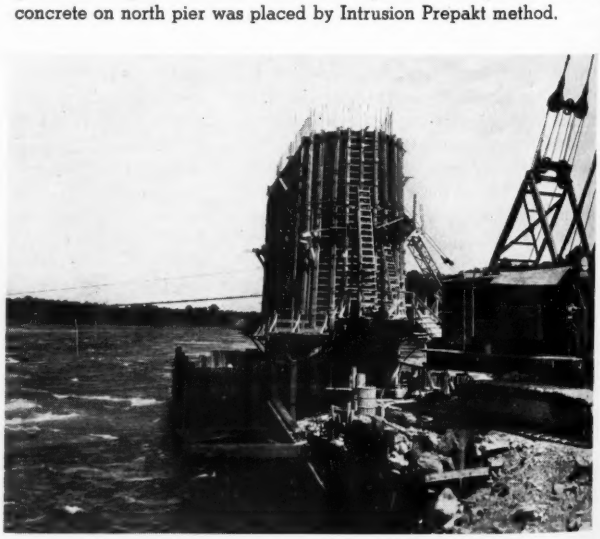
While the dike was progressing, a large timber icebreaker about 40 by 36 ft and 40 ft high, weighing about 80 tons, was built on shore. This icebreaker was to be permanently located 30 ft upstream from the main pier and on it a crawler crane was to be mounted for constructing the cofferdam, which would consist of a single wall of DP-2 sheetpiling 52 ft long. By this time, because of the severe winter we were having, with temperatures as low as −30 deg F, the ice started to jam at Lake St. Francis 30 miles downstream. This ice jam backed up the water and raised its level 7 ft at the bridge site.

The St. Lawrence River does not normally fluctuate over 3 ft in height and is subject to serious floods only during the months of February and March when the ice jams in Lake St. Francis. As a rise in the river seemed imminent, it was deemed advisable to delay launching the icebreaker and starting the pier cofferdam until the ice jam had broken.

At the bridge site the river does not freeze because of the velocity of the current, but it does carry a considerable quantity of ice of two kinds—frazil ice which is formed on the top of the water, and anchor ice which is formed on the bottom of the river. The anchor ice rises to the surface when exposed to a slight change in water temperature or when it has reached sufficient dimensions to be dislodged from the bottom by the fast water above it. For a time the wire basket and anchor cables were subjected to considerable pressure from the floating ice, but as the river rose and covered the basket, this problem was eliminated. Construction operations in the river were shut down during this period.

It was not until approximately a month later, the first part of March, when the river started receding after the ice broke loose at Lake St. Francis, that our major troubles began. During the night when this occurred, ice breaking loose upstream exerted an irresistible pressure against the cables and basket, breaking the basket loose from its moorings and destroying all but the inshore portion of the dike. When the river had dropped to within 2 or 3 ft of its normal level, we started to build another basket, larger and more substantial. Since, in building the first basket, we had found that the theoretical horizontal water pressures were not as large as computed, we felt that a heavier steel unit could be built, with a larger surface area exposed to the current. This would prevent failure of the

Forms are in place for last lift of concrete on south pier. Note 2 $^1/_2$-in. grout line suspended from cable to left of pier. Through this line all concrete on north pier was placed by Intrusion Prepakt method.



supporting members used for the framework. This second basket was built and launched successfully in March while heavy ice was still running in the river. Unfortunately, after being in service for a week, this basket also went out when large cakes of ice rode up on the anchor cables and jammed against the side of the basket.

A third basket was constructed in the latter part of March. This basket was built in three units each 12 ft long, instead of in one unit, and was anchored by driving H-beams into the rock and sheetpiling on the inside. The latter also served to prevent the rock fill from breaking out through the wire mesh. In the meantime the amount of ice carried by the river had diminished with the coming of warmer weather. This third basket held firm until completion of the pier, although the discharge in the river ran 20 percent above normal during the spring months.

On completion of the basket, we immediately launched the icebreaker, floated it into position with pontoons and sank it in proper position. It was then loaded with rock and served as a working platform to support the crawler crane which constructed the pier. A second crane, mounted on a barge, handled the pier piling and concrete.

As the borings had indicated that there was only 2 ft of overburden on top of the rock, it was necessary to provide a support to hold the cofferdam in position against the turbulent water. To provide this support a frame of H-beams was attached to the timber icebreaker. Two 33WF200 beams 76 ft long were floated into position and attached to the H-beam frame. The cofferdam frame then was floated between these two beams, which formed a yoke to which the frame was bolted. Besides holding the frame in position, the yoke beams stiffened the cofferdam against the force of the current. Sheetpiling was then driven around the frame in the normal manner. To do this the entire area of the cofferdam was dredged with a clamshell to remove all the large rock that had been swept down from the dike by the current as well as loose river-bottom rock. Unfortunately some big rock remained and was only removed after considerable work with a diver and crane. The H-piles and sheetpiling were then driven to refusal into rock. As part of the revised design, it was decided to leave this sheetpiling in place, cutting it off 18 ft below water level.

The north end of the bridge on Barnhart Island was not accessible from the American side until the latter part of June, when the floating bridge was completed. A road had been built on the Canadian side to bring in light materials and equipment utilizing a 5-ton bridge across the Canadian canal. Heavy equipment was barged across the quiet Sheek Island channel to Barnhart Island. Men were transported by launch from the American side.

To avoid setting up a separate concrete plant on the Barnhart Island side, it was decided to use the Intrusion Prepakt method of concreting. This method permitted us to pump the grout across the river from a plant set up on the south side. Stone aggregates for the north side were brought in during the winter months in small loads by a Canadian producer while the ground was still frozen.

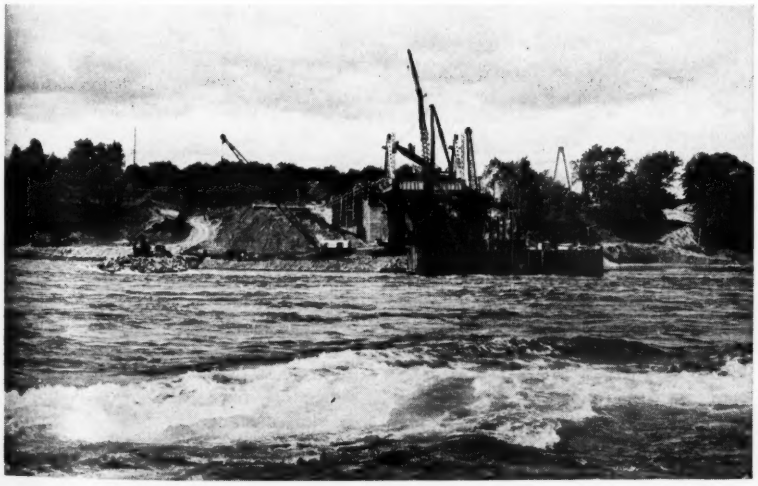
It was necessary to install two $2^1/_2$-in. grout lines across the river—one for a spare should a line plug. Our plans called for laying these lines on the river bottom as we thought it would be easier and cheaper, but unless the pipes could be laid on the bottom of the river, where velocities are low, we could not expect to hold them against the current. When we attempted to lay a cable across the river on the bottom, it was swept in a long arc 1,000 to 1,500 ft downstream and would not sink. Several attempts had previously been made to stretch a $^7/_8$-in. cable across the river, and this was accomplished only by holding the cable above the water with crawler cranes. Thus 3,000 ft of pipeline appeared necessary to cross 950 ft of water, and there was no certainty that the pipe would sink. The only other solution was to place a tower on each shore and hang the two pipes from two $^7/_8$-in. cables suspended from the towers. All the concrete grout for the north side was pumped in these pipes across the river.

Compared to the difficulties encountered on the south side in providing still water for the work area, the dike for the north pier was relatively simple. The water was shallower and slower, although velocities on the north side had increased to 10 or 12 miles an hour because of obstruction of the river channel by the dikes extending out from the north and south shores, which decreased the original river width by about half.

In the construction of the 200-ft-long north dike, we had no loss of rock in a 27-ft depth of water, and also were able to throw the current out into the river 50 ft from the end of the dike. Much of this dike consisted of coarse gravel, from a pit on Barnhart Island, and only the outer 60 ft required rock.

I have endeavored to cover only the unusual features of the work. Other phases of the construction were handled in the customary manner. To solve the problems created by the fast and deep water, it was necessary to resort to methods of trial and error. We now appreciate more fully the value of a background of wide experience in solving new problems. It surprised us to find how much we relied on our past experience and, when we were faced with a completely new set of conditions, how difficult it was to come up with the correct solution the first time.

North cofferdam is completed and abutment on Barnhart Island progresses rapidly. American Bridge Company has started to erect superstructure steel.



(This paper was originally presented by Mr. Wikstrom at the ASCE Annual Convention, before the Construction Division session presided over by Charles D. Riddle, Chairman of the Division's Executive Committee.)

SPILLWAYS AS DESIGNED BY CORPS OF E

FRANCIS B. SLICHTER, M. ASCE

Chief, Engineering Division, Civil Works Office of the Chief of Engineers,

As a science, hydrology was in its infancy when the Congress, by passage of the Flood Control Act of 1936, placed supervision of improvements of the Nation's rivers for flood control under the Chief of Engineers, Department of the Army. Not only were the records of actual flood history for the Nation's rivers scanty, but also very little research had been accomplished in the field of maximum possible storms. At that time it was the usual practice to design a spillway to pass a discharge about twice that of the largest flood recorded in the vicinity of the dam.

Better flood forecasting

Among the first actions of the Corps of Engineers under their new responsibility was the adoption of measures which would lead to greater accuracy in estimating the maximum possible flood. Included were the installation of a comprehensive nation-wide network of recording precipitation and stream gaging stations, establishment in cooperation with the U.S. Weather Bureau of a Hydrometeorological Section to assist in the determination of meteorological factors governing major flood-producing storms, and initiation of an intensive study of major flood-producing storms of record.

Although an early start was being made in advancing knowledge in the field of hydrometeorology, at the same time the Corps of Engineers was faced with the necessity of designing flood control dams for immediate construction. These structures were to be built in river valleys where destruction of the dam by overtopping would cause loss of life and property damage that could be measured only in terms of a national disaster. Consequently, in the early work of the Corps, the maximum flood considered possible was estimated using all the data available and then adding from 25 to 50 percent as a factor of safety in obtaining the spillway design flood.

Over the years, with the accumulation of rainfall and stream-flow records under the new programs, with the improvements in hydrometeorological background, and with the accumulation of experience in design and actual operation of projects for flood control, greater confidence came to be placed in estimates for the maximum possible flood. Accordingly, the practice of adding an arbitrary percentage as a factor of safety was discontinued by the Corps in the early 1940's.

A comparison of historic floods of record with spillway design floods adopted by the Corps in the design of 150 reservoir projects is given in Table I. The ratios shown compare the estimated peak flow of the adopted spillway design flood (SDF) with peak flows of maximum floods of record (MFR) at or near the dam sites. For recorded floods, the period of record averaged 14 years for the entire group; 26 projects had periods of 25 years or longer; and 5 projects had records of over 50 years.

TABLE I. Comparison of adopted spillway design floods with maximam floods of record

Drainage Area Above Dam, Miles	Average Ratio, SDF/MFR	Range in Ratio for 90 Percent of Projects
100	5.2	2.2 to 15.0
1,100	4.0	2.0 to 10.0
10,000	3.0	1.8 to 6.4
100,000	2.4	1.7 to 3.9
250,000	2.0	1.6 to 3.2

TABLE II. Application of criteria in design of spillways

No. of Dams Where Features Apply	Design Features
19	Remotely located spillway, no stilling basin
12	Ogee crest designed for less than maximum head
11	Flip type or roller-bucket structure
18	Depth of stilling basin reduced about 10 percent
25	Length of stilling basin reduced about 25 percent
21	Walls of stilling basin shortened about 25 per cent
4	Walls of stilling basin lowered about 25 percent

Because the spillway design flood has been estimated as the maximum possible flood, it is of rare occurrence. Its storage or control is not a project purpose, as the flood control function of the project is served by control of the reservoir design flood, which is generally comparable to floods that are characteristic of the region. However, passage of the spillway design flood through or over the dam or its abutments within the limit set for freeboard is the basic criterion for spillway design.

Recognition of the rarity of occurrence of this flood has enabled the Corps to develop design practices resulting in economy of spillway design while still satisfying the criterion for safe flood passage. These practices are based on the premise that structural damage may be accepted during passage of the spillway design flood, provided that the security of the dam is not jeopardized.

Design policy of Corps

Where topography is favorable, the spillway is located in the reservoir rim sufficiently remote from the dam to eliminate damage to the dam due to uncontrolled spillway discharge. An unlined spillway is used where the foundation rock is sound, or a relatively inexpensive spillway structure consisting of a narrow paved surface or weir is provided where the foundation is not so favorable. Paving of the spillway discharge chute may be eliminated in part or totally. An application of this practice is shown in a photograph of the spillway discharge channel and control structure for Jemez Canyon Dam, New Mexico. The dam, an earth-filled embankment, is 3,700 ft from the spillway.

Where stability considerations permit, crests of concrete overflow sections are designed for from 75 to 90 percent of the head required to pass the spillway design flood. This design accepts a slight negative pressure on the downstream face of the dam under maximum discharge, but provides improved efficiency of discharge for all flows. Thus there is a saving in the length of the

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Department of the Army, Washington, D.C.

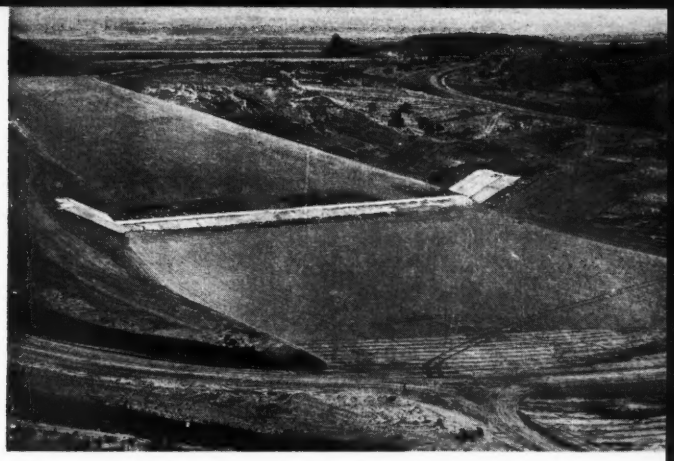
spillway crest, the number or length of gates, and the width of stilling basin or alternate features.

Where control of the velocity of spillway discharge is essential to project operation or structural security, a stilling basin is included. Wherever these criteria do not govern, a less costly flip structure or roller-bucket stilling structure is used. A photograph shows the flip bucket constructed at the recently completed 440-ft-high Pine Flat Dam in California.

In those designs requiring stilling basins, economies in construction are realized by designing features of the structure for optimum stilling action at a discharge less than the peak flow during the spillway design flood. Stilling-basin depths and lengths have been reduced from the theoretical requirement of the spillway design flood, and basin training walls have been shortened and lowered. In event of passage of the spillway design flood, the hydraulic jump could sweep out of the basin, and the basin walls would be overtopped. Under such operation, erosion of the stream bed and river banks would be tolerated as well as repairable damage to the stilling basin. The Corps' criteria accepts this rare potential, provided that the security of the dam is not jeopardized. An application of this practice at Whitney Dam, Texas, is shown in another photograph. The design provides for a short stilling basin flanked by low training walls that would be overtopped during passage of the spillway design flood.

Applications of these practices in the design of sixty dams either completed or now under construction by the Corps are summarized in Table II.

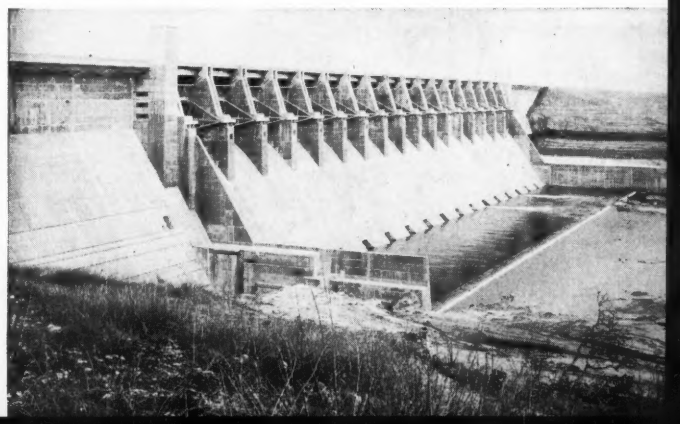
The criteria developed by the Corps of Engineers for design of spillways as presented above applies to dams and reservoirs located where a dam failure would result in heavy property damage or probable loss of life. It is believed that these hydrometeorological procedures and design practices provide at minimum cost the required insurance against destruction of the dam by the maximum possible flood.

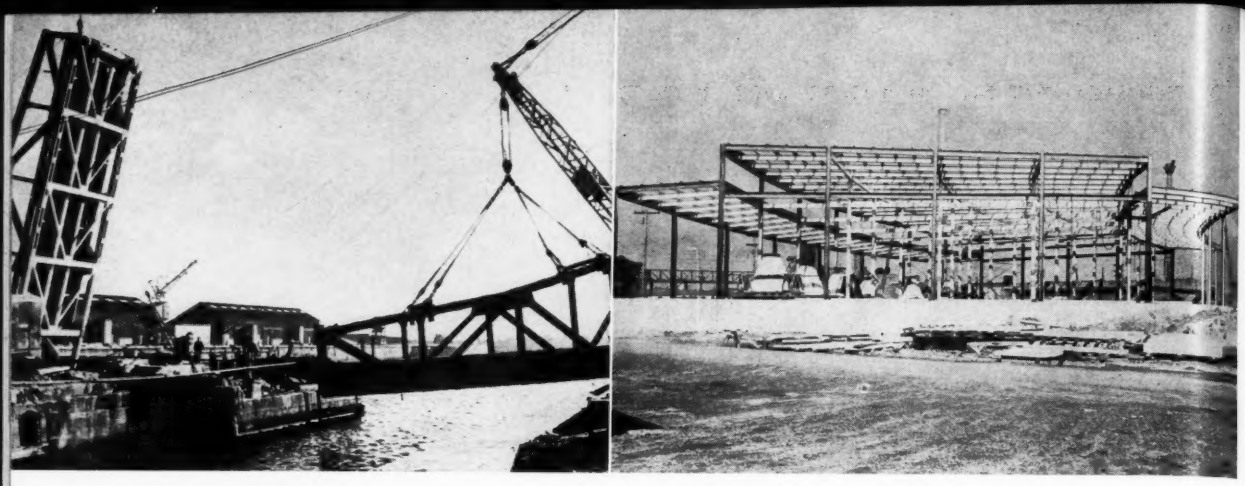


Paving on spillway discharge channel may be eliminated where topography is favorable, as illustrated by spillway for Jemez Canyon Dam, New Mexico. Short concrete section flanked by riprap in middle distance is designed to control erosion in unlined channel, which is excavated in Santa Fe formation, soil-like material composed of uncemented silts and sands. Earth-fill dam is located 3,700 ft from spillway.

Where it is not essential to control velocity of spillway discharge, less costly flip-bucket structure may be used, as at Pine Flat Dam in California, 440 ft high. Note that lower tier of sluices discharge below spillway bucket.

Depths and lengths of stilling basins have been reduced and training walls shortened and lowered, with expectation that basin will suffer repairable damage in event of occurrence of spillway design flood. Spillway at Whitney Dam in Texas illustrates this use of short stilling basin and low training walls.





First aluminum double-leaf trunnion bascule (above left) was erected at Hendon Dock Junction, Sunderland, England. Structure required 115,000 lb of aluminum plates and shapes. Use of aluminum frame for engine house (above right) was found feasible because of resistance to sulfurous fumes from steam-engine exhaust. Maintenance is thus reduced and life prolonged.

ALUMINUM ALLOYS

move into structural markets

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Structural applications of aluminum are surging ahead on the crest of an ever-increasing demand from designers and builders. Alcoa, in 1928, had only 1 percent of its total sales going into the building products market. In 1954, the company reported a jump in these sales to over 20 percent. Now, during the greatest construction boom in history, this outlet promises almost unbelievable new horizons.

Certain outstanding developments—notably the perfection of aluminum alloys—have made all-important contributions to this thriving structural market. Aluminum in its commercially pure form has only a limited number of applications, since its ultimate tensile strength approximates 10,000 psi. While this figure can be doubled by cold-working, the resulting strength is still not within the useful structural range. The answer has been found in alloying elements—notably copper, magnesium, silicon, manganese, and zinc. For instance, the small amounts of iron and silicon present in what is still called commercially-pure metal (Alloy 1100) increases the strength, in the annealed condition, by some 45 percent. The ultimate tensile strength of Alloy 5052, containing 2.5 percent magnesium—also in the annealed state—is about three times that of the pure metal.

Subsequent cold-working brings the tensile strength of alloys within satisfactory ranges. Cold-working an alloy containing 2.5 percent magnesium, for example, increases the strength to four times that of annealed pure aluminum.

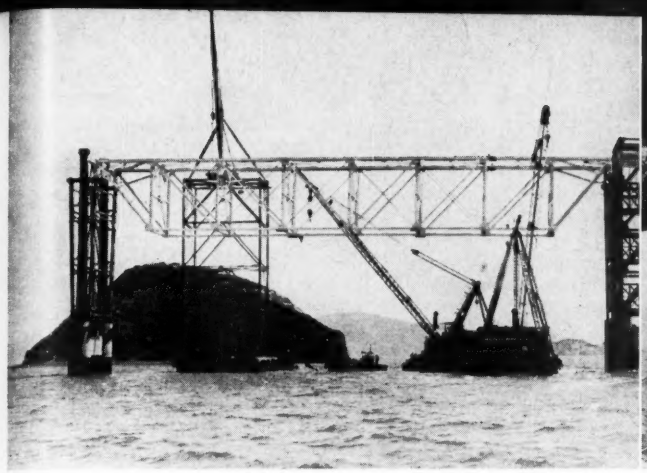
Various desirable combinations of properties can also be secured by different types of heat treatment, or by combining heat treatment with small amounts of cold working. Wrought alloys are available in heat-treated tempers with strengths in excess of 80,000 psi, and casting alloys can be heat-treated to strengths of nearly 50,000 psi. Alloys that will respond so favorably to heat treatment can be produced only by the proper selection of alloying elements.

Numbers, rather than names, designate aluminum alloys. Rarely is an alloy designation used both for wrought products and for castings. The temper designation consists of a letter followed by a number, and is placed after the alloy designation, and separated from it by a hyphen.

Of the more than twenty available wrought alloys, each with its own group of temper designations, two are of particular value for structural applications. These are known commercially as 6061-T6 and 2014-T6. As noted by the "T6," both are used in the heat-treated condition. Both are available in all the usual forms—sheet, plate, shapes, rod, bar, tube, pipe, and forgings.

Alloy 6061-T6, of moderate strength, is characterized by its high resistance to corrosion. It has a minimum ultimate tensile strength of about 40,000 psi, and a minimum yield strength of 35,000 psi (at 0.2 percent elongation). A basic allowable tensile design stress of 15,000 psi is generally used.

Alloy 2014-T6 has a relatively high copper content, and in it some degree of corrosion resistance has been sacrificed for increased physical properties. This alloy is used primarily for structures in which high strength and light weight are particularly significant. The minimum



One of two aluminum trusses used as falsework for erection of Richmond-San Rafael Bridge in California is put in position, completely erected, by two floating derricks (above left). Aluminum trusses will be reused to erect 28 of the 36 truss spans, each 289 ft long. Aluminum is finding a market for lighting standards, as seen on Delaware River Joint Toll Bridge Interchange (above right).

ultimate tensile strength is 60,000 psi and the minimum yield strength (at 0.2 percent elongation), 53,000 psi. While 2014-T6 is usually painted, 6061-T6 is ordinarily used in its natural state.

In general, the design of aluminum alloy structures follows the same pattern employed for other structural materials. Special attention to deflection, column strength, and local buckling characteristics is usually required. The modulus of elasticity of aluminum alloys is approximately 10,000,000 psi. This means that an aluminum alloy beam of a given size, span, and loading will deflect approximately three times as much as a similar steel beam. For applications in which this deflection is undesirable, the beam depth is normally increased. Usually, a weight saving of about 50 percent is obtained where the depth of the beam is not limited. This compares with a 65 percent weight saving in a size-for-size substitution for steel, since aluminum alloys weigh about one-third as much as steel.

This lower modulus of elasticity, characteristic of aluminum alloys, also affects column strengths. On long columns the allowable loading for Alloy 2014-T6 is less than that for mild steel. On short columns the allowable loading is greater than that for mild steel, because of the higher yield strength and the lack of a flat spot in the stress-strain curve. In the transition range between long and short columns, where the bulk of the column members are found, the aluminum alloy column must generally have larger cross-sectional dimensions than a comparable steel column, to use the metal efficiently. This design change usually results in a column weighing about half that of steel.

Local buckling of structural members is related to the modulus of elasticity of the material. Consequently the designer must be alert to the proportions of flanges and webs of aluminum alloy members in order to insure against premature failure of columns or compression flanges of beams and girders by local buckling.

Summarizing the design characteristics of the structural aluminum alloys 6061-T6 and 2014-T6—the tensile strengths lie in the range of structural carbon and low-alloy steels respectively. The modulus of elasticity is one-third that of steel, requiring special attention to compression members. Weight savings of approximately 50 percent may be expected for smaller structures, while savings of over 65 percent may be possible in larger structures where dead weight is a significant factor. Measurable savings are involved in the cost of maintenance of aluminum structures.

Fabricating aluminum members

Nearly all accepted fabricating procedures used by structural steel fabricators can be employed when working with aluminum alloys. Sawing and drilling of the thicker members is preferable to shearing and punching. Flame cutting of aluminum alloys is not acceptable, because the material melts rather than burns. Also, the high temperature lowers the strength of the metal by eliminating the effect of previous heat treatment. Clean, sharp tools are essential to good forming operations. To facilitate bending, Alloy 6061-T6 may be heated to a temperature not exceeding 400 deg F for a period of time not exceeding 30 min. The maximum heating time for Alloy 2014-T6 is reduced to 15 min. Severe forming operations are not recommended for the latter alloy.

Structural aluminum alloys can be assembled by riveting or welding, although riveting is the preferred method of assembly for heat-treated alloys. The heat of welding reduces the physical properties of these alloys in the immediate vicinity of the weld bead. Welding of Alloy 2014-T6 assemblies is not ordinarily recommended.

Aluminum alloy rivets may be driven hot or cold, the selection depending on the alloy, the required shear strength, and accessibility. Higher shear strengths are obtained with cold-driven rivets. Cold-driven rivets of Alloy 6061-T6 are normally recommended for Alloy 6061-T6 assemblies. A design strength in shear of 10,000 psi is generally used. Cold-driven rivets of Alloy 2117-T3 are normally recommended for structures of Alloy 2014-T6. The use of a design shear strength of 10,000 psi is common practice. Cold riveting is recommended for shop work, where squeeze riveters may be used.

Aluminum rivets over $1/2$ in. in diameter are difficult to drive cold with pneumatic hammers. Therefore hot-driven rivets of Alloy 6061-T43 are normally used for both Alloy 6061-T6 and Alloy 2014-T6 where hammers must be used. These rivets are heated in an air-circulating, controlled-temperature furnace to from 990 deg F to 1050 deg F before driving. Design shear strengths of 8,000 psi are the rule.

Generally, an aluminum assembly consisting of tubular products, special extrusions, and castings, can be competitive with other materials in the same forms. However, an aluminum structure, fabricated of standard commercial plates and shapes, would be expected to

cost at least twice that of a similar steel structure. This is due largely to the higher cost per pound of the aluminum material. Usually handling and erection costs, and the lack of need for painting, will offset some first-cost differential. This has certainly been true of recent installations of highway railings, large informational signs, electrical substations, and street-lighting standards.

Where to use aluminum

With a history dating back to 1928, aluminum alloys have gained widespread acceptance in the field of highway railings. Today there is scarcely a bridge design engineer who is not considering aluminum bridge railings, either parapet type or panel type. With the use of deck-type structures for high-speed trafficways, the roadway and the railing are about the only components evident to the motorist. Thus the appearance of bridge railings is becoming increasingly important to the designer.

Before World War II, it was felt by some engineers that the improved appearance and uniqueness of aluminum alloys were the only factors recommending their use for bridge railings. In some cases—for instance on the rehabilitation of old bridge structures—the light weight of aluminum alloys was an important consideration. Maintenance-free service of the railing was also an advantage. According to available information, no aluminum bridge railing has ever required painting, including some that have seen almost 30 years of service.

Since World War II, with the increased availability of aluminum alloys and their lower relative cost compared with competitive metals, aluminum bridge railings have been widely accepted. In addition to all the characteristics that had previously been contributing factors, lower first cost, and in some instances, competitive first cost, have become increasingly important.

One of the more notable locations where light aluminum railings are used almost exclusively is the District of Columbia. The State of Missouri has adopted aluminum alloys as a state standard, and so has the Commonwealth of Pennsylvania, as exemplified by the Penn-Lincoln Parkway in Pittsburgh and the Schuylkill Expressway in Philadelphia. In the bidding on the Ohio Turnpike, two types of parapet rail were specified, each in either steel or aluminum. Because of lower first cost, over 80 percent of the 50 miles of railing on that turnpike will be aluminum.

Use of extruded aluminum panels for the large informational signs on the Ohio Turnpike resulted from the development of a new technique for sign construction. Now highway signs of varying height and width are being built by using extruded panels 12 in. wide in lengths up to about 34 ft. For instance, a sign 9 ft high by 16 ft long would be constructed by using nine 12-in.-wide extruded panels 16 ft long, mounting the panels one on top of another until the desired height was obtained. The panels are joined to the sign posts with aluminum clips, which are attached to the panels.

Aluminum floor grating and tread plate often are used where light weight and resistance to corrosion are desired. Approximately 40,000 sq ft of aluminum floor grating is specified for the emergency walkways on the Delaware River Bridge at Gloucester, Pa. Other similar installations are forthcoming.

Aluminum traffic-control arches were chosen for the Philadelphia-Camden Bridge to support the signals controlling the eight lanes of traffic. Having a clear span of 84 ft, each of the eight arches weighs 8,700 lb. Each arch was fabricated in one piece and erected by only one truck crane with a minimum of delay to traffic. More structures of this type are under consideration.

One of the earliest applications of aluminum alloys to bridge construction occurred during the fall of 1933, when the 50-year-old Smithfield Street Bridge in Pittsburgh was rehabilitated. The heavy timber deck and steel floor system were entirely replaced with aluminum floorbeams, stringers, joists and deck. A double-track street railway, a two-lane highway, and two sidewalks are accommodated on this structure. A total of almost 700,000 lb of aluminum alloys were used on the two main spans of 360 ft each. The old trusses were sufficiently unloaded by the use of this lightweight floor system to provide a weight saving of approximately one ton per linear foot. Thus, they could safely support modern traffic loadings.

During World War II, the Engineer Research and Development Laboratories at Fort Belvoir, Va., developed the M-4 floating bridge, employing aluminum boats and aluminum roadways. The metal roadway consisted of hollow box beams, known as "balk," performing both as stringers and as the wearing or traffic surface. The ends were closed so that the members would float, and the top surface was provided with notched ribs to insure good traction. The balk was actually fabricated by welding two channel-type extrusions together down the neutral axis. The value of this type of bridging equipment was thoroughly demonstrated and proven in combat.

Since World War II, considerable work has been done in designing and testing heavy tactical bridges, with the result that several such bridges have been developed, including the T6. This portable bridge consists of a pony truss assembled from panels approximately 15 ft long by 8 ft high. By using these panels in duplicate or triplicate the roadway width can be increased from 14 ft 6 in. to 22 ft, or increased loadings can be accommodated. The bridge will support a 60-ton tank on a 150-ft span. The lightweight panels are easily handled under hazardous conditions. Air transport is also facilitated.

One of the seven girder spans in the Grasse River Railroad Bridge at Massena, N.Y., erected in 1946, is fabricated of aluminum alloys. The aluminum girder span is 10 ft deep, 100 ft long, and weighs 53,000 lb. This girder span was completely shop-fabricated and erected in one complete assembly. In contrast, the similar steel spans—9 ft deep, 100 ft long, and weighing 128,000 lb—had to be erected one girder at a time. All spans were designed for Cooper's E-60 loading and are of conventional design and construction.

The purposes of this undertaking were three: (1) to demonstrate the feasibility of aluminum alloy construction for railroad bridges; (2) to determine whether conventional design and fabrication methods for aluminum alloys were practical for full-scale production; and (3) to permit study of the deflection, vibration, and corrosion characteristics of comparable steel and aluminum structures. The aluminum girder span has successfully passed the most rigorous tests, and shows every promise of continuing to perform in a satisfactory manner.

In the field of movable bridges, two aluminum double-leaf trunnion bascule bridges have been built in England. The first of these, erected at Hendon Dock Junction, Sunderland, in November 1948, has a length of 121 ft, $1\frac{1}{2}$ in. between trunnion bearings, and accommodates a 9-ft roadway, one standard-gage track, and two sidewalks. This bridge required 115,000 lb of aluminum plates and shapes, and saved more than half the weight of a comparable steel bascule.

The second aluminum bascule bridge was completed in September 1953, at Victoria Dock, Aberdeen, Scotland. It is also a double-leaf trunnion type, designed to carry road and rail traffic. With a clear span between trunnions of 100 ft, the 22-ft roadway carries a double line of traffic and a single-track railway, plus two 5-ft sidewalks. About 96,000 lb of aluminum alloys were used in this bridge.

In 1949, the town of Arvida, Canada, built the world's first aluminum arch bridge, a highway structure over the Saguenay River. (See article by C. J. Pimenoff, CIVIL ENGINEERING, August

M. Harvey Taylor Bridge in Harrisburg, Pa., has all-aluminum railings. Aluminum was chosen on a first-cost basis in competition with other railing materials.

All-aluminum facing on Alcoa Building in Pittsburgh marks trend toward metallic skin in modern building construction. Speed of erection and low maintenance are key factors in this application of aluminum to structures.

1950.) The central arch span has a length of 290 ft and a rise of 47 ft 6 in. The total length, including approaches, is 504 ft. This bridge accommodates a 24-ft roadway plus two 4-ft sidewalks. It contains approximately 400,000 lb of aluminum alloys. A comparable steel span would have weighed twice as much.

Some unusual uses

Perhaps the most newsworthy application of structural aluminum alloy at the present time is for falsework trusses being used in the construction of the Richmond–San Rafael Bridge. This crossing of San Pablo Bay, Calif., is the largest bridge under construction today. When completed, it will be the second longest over-water bridge in the world.

It consists of thirty-six 100-ft girder spans, two cantilever spans, and thirty-six 289-ft truss spans. Twenty-eight of the truss spans will be erected entirely on aluminum falsework. This falsework consists of two complete aluminum spans, weighing about 225,000 lb each and measuring 285 ft long by 36 ft wide by 42 ft deep. Each aluminum span can be used at any location for erection of the truss spans, and erection can be carried out simultaneously on each span in different locations. Each aluminum span is floated out to the job site and then hoisted into position between piers by two conventional derrick barges. The aluminum span is supported on temporary wood bents attached to the steel towers. It supports the individual members of the steel truss span until the latter is assembled and self-supporting.

Another type of unusual structure is the aluminum alloy conveyor bridge installed in 1947 by the Freeport Sulphur Co. at Grand Ecaille, La. Consisting of three girder spans, each approximately 65 ft long and 5 ft high, it supports a large conveyor belt which transports bulk sulfur from storage piles to nearby railroad hopper cars. The entire structure moves laterally on crawler-tractor treads to service all parts of the storage piles. Approximately 75,000 lb of aluminum alloys were used in this unit.

Use of aluminum alloys for building frames cannot ordinarily be justified on the basis of either light weight or resistance to corrosion. However, the feasibility of aluminum alloys for the frame of the railroad engine house shown in a photograph was established, since they would reduce maintenance and increase the life expectancy of this structure, which must resist corrosive attack by the sulfurous exhaust from steam locomotives.

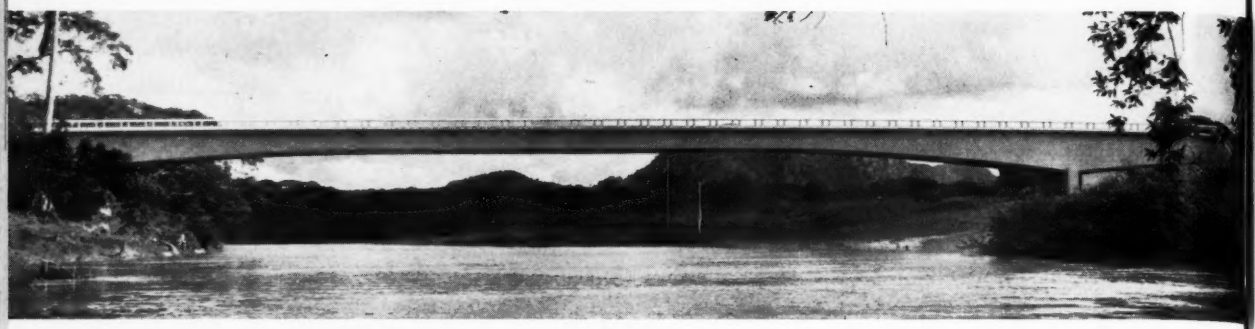
The first and foremost example of the use of aluminum alloys for the exterior treatment of buildings is probably the new Alcoa Office Building in Pittsburgh, which is completely enclosed in aluminum panels. This 30-story building is sheathed in aluminum-alloy stamped sheet panels, roughly 6 × 12 ft in size, $\frac{1}{8}$ in. thick, and weighing about 210 lb each. The top half of each panel contains a pivoted aluminum framed window 4 ft 2 in. wide by 4 ft 7 in. high. The bottom half is depressed into an architecturally pleasing, inverted-pyramid pattern about 7 in. deep.

These panels were erected by workmen from the floors of the building itself, without the use of outside scaffolding, booms, or derricks. A special lightweight concrete, made of perlite, was sprayed onto slotted aluminum lath within the building after the exterior panels were in place. This type of construction, from the outside to the inside, permits workmen to proceed in all types of weather. Since the aluminum skin never requires painting or calking, all regular maintenance costs are sharply reduced.

There is no question that the use of aluminum alloys in all types of structures is rapidly increasing. It is the industry's fond hope and expectation, however, that the future will lead to a still broader role for aluminum alloys in structural work.

(This article has been prepared from the paper presented by Mr. Pickett at the Highway Short Course given at Texas A. & M. College late last spring.)

PRESTRESSED CONCRETE BRIDGE IN CU



LUIS SAENZ, M. ASCE, and IGNACIO MARTIN, J.M. ASCE

Partners, Saenz-Cancio-Martin, Engineers, Havana, Cuba

ON the projected route of the Cuban branch of the Pan American Highway, an unusual prestressed concrete box-girder bridge gracefully spans the treacherous Cuyaguateje River. Its daring design was based on experience with three similar bridges of shorter span recently designed and completed by the same engineers. The 298-ft 6-in. clear length of the center span of the Rio Cuyaguateje Bridge probably is a Western Hemisphere record for bridges of this type.

About two miles from Mendoza near the western end of Cuba, the Cuban branch of the Pan American Highway crosses Rio Cuyaguateje, the largest river in the western provinces. When completed the highway will have ferry connections from Havana to Key West and from La Fe to Mexico. The river is subject to flash floods during which it can rise 25 ft above its normal level, attaining velocities of more than 7 ft per sec. Since the flood flows carry much debris, including whole trees, it is not practicable to use piers for a bridge crossing over this river.

Borings were made on both sides of the river at several possible locations for the bridge. In all of them was found an upper layer of soil, followed by a layer of altered limestone rock full of cavities and cracks. Not very far below these strata lies sound, dense, Cretaceous limestone of excellent quality which extends to a great depth. This limestone was selected as ideal for the foundation of the bridge and also proved an excellent source of coarse aggregate for the concrete structure.

The designers had had previous experience in Cuba with steel bridges of span lengths up to 300 ft; with normally reinforced concrete bridges up to 200 ft in span; and with prestressed concrete bridges up to 250 ft in span. This experience led them to select a prestressed concrete structure of about 300-ft span for the Rio Cuyaguateje crossing. This design was considered to be feasible from the construction standpoint and competitive in initial cost with an equivalent steel structure. Maintenance costs would be negligible even in a tropical country where corrosion of steel structures is a serious problem.

Stated simply, the bridge consists of a concrete box girder 367 ft long resting symmetrically on two piers 298 ft 6 in. apart (Fig. 1). The shore ends of the side spans are anchored down into the rock by cables.

After a few tentative preliminary studies, the central span of the bridge was finally designed as a two-cell hollow box-girder of uniform width but decreasing in depth from the piers toward the center to lighten its weight. The design adopted produced a silhouette of striking slenderness. End spans were designed to be solid and to be anchored to rock so as to provide practically full restraint for the central span at the piers. Added inertia and resistance were obtained by increasing the depth and wall thicknesses of the hollow box-girder of the main span near the piers and by adding prestressing cables of variable length in the top slab over the piers.

Studies were made of both shorter and longer end spans with a larger

CUBA SPANS NEARLY 300 FT

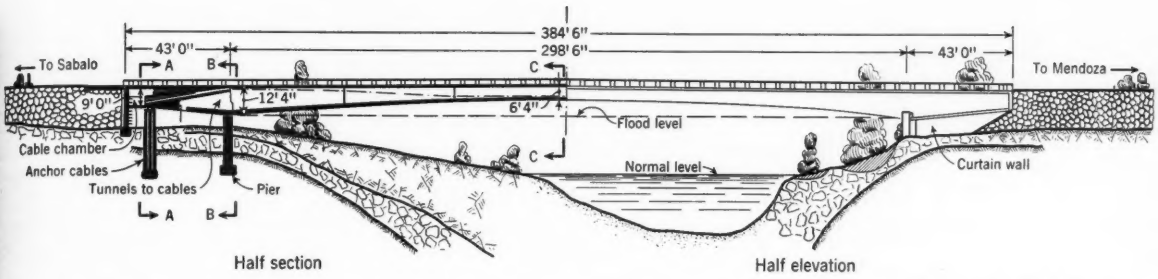


FIG. 1. Striking slenderness contributes to beauty of Rio Cuyaguateje Bridge on Cuban branch of Pan American Highway.

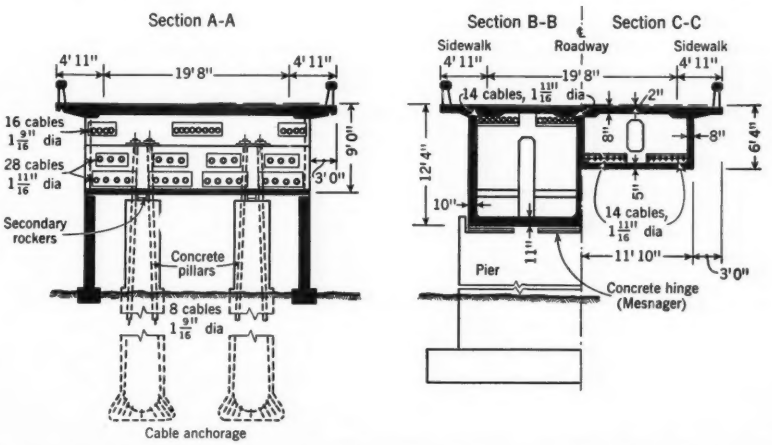
or smaller number of anchor cables respectively. The length chosen between piers and anchor cables (34 ft 5 in.) provided the most economical solution considering the cost of concrete, reinforcing steel, forms, rock excavation, and high-strength steel-wire cables at the time of construction.

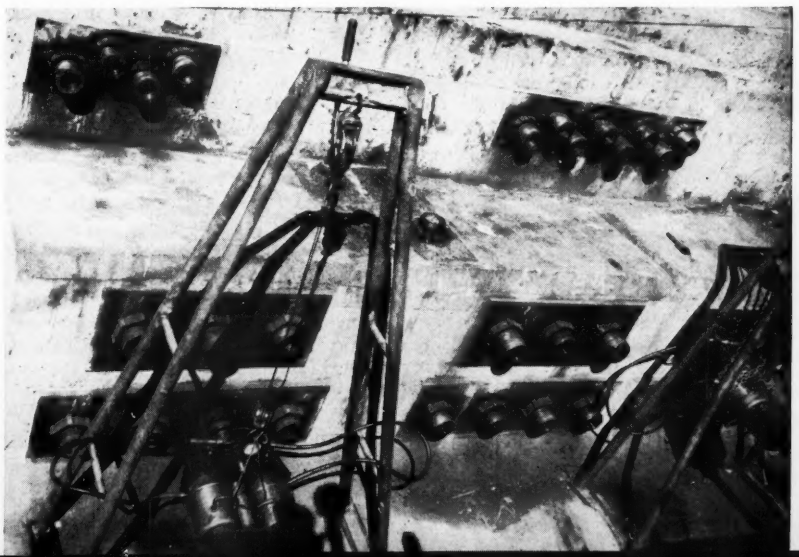
The 29-ft 6-in. width of the bridge provides for two lanes of traffic and a 5-ft sidewalk on each side. The design is based on a live load of AASHO H-20-44.

As can be seen in Fig. 2, the two-cell box girder, which has a uniform width of 23 ft 6 in., has three vertical walls 8 in. thick, a top roadway slab 8 in. thick (which overhangs the side walls by 3 ft), and a bottom slab 11 in. thick at the piers decreasing to 5 in. thick at the center of the span. The depth of the hollow girder at the piers is 12 ft 4 in., and it decreases according to a parabolic curve to 6 ft 4 in. at the center of the bridge. The ratio of bridge depth to clear-span length at the center of the bridge is about 1:50.

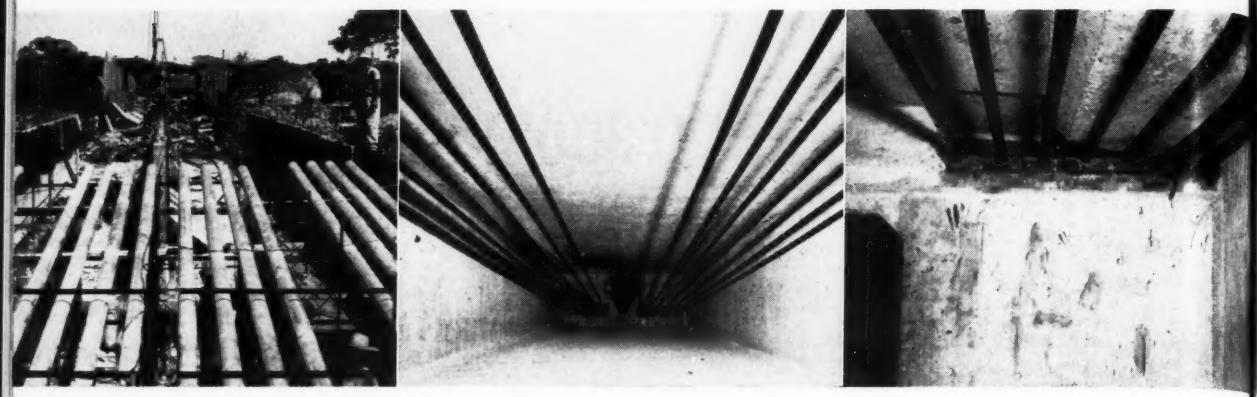
On the fixed-end pier (Sabalo end) the bridge is supported on a reinforced concrete hinge of the Mesnager type.

FIG. 2. Cross sections of bridge at anchorage (A-A), at pier (B-B), and at center of main span (C-C) show principal dimensions and locations of three sets of cables.





End fittings of cables remain exposed in cable chamber. Slab cables are at top, and on shelf are fittings for vertical anchor cables. Fittings for main strands are at bottom. Prestressing equipment is in position in foreground.



At the other pier (Mendoza end), it rests on three steel rocker bearings (Fig. 3). Secondary adjustable rocker-type steel hinges support the shore ends of the side spans.

Concrete with a strength of 5,000 psi in 28 days was used in the box section of the bridge. Coarse aggregate was made at the site, and silica sand came from the river. The required strength for the 637 cu yd of concrete in the box section was attained readily by using 7.7 sacks of cement per cu yd. In the end spans, 660 cu yd of 3,000-psi concrete were poured. Although the superstructure is but lightly reinforced, 46 tons of structural-grade reinforcement went into it.

At full load the maximum stress in the concrete is about 1,800 psi, that is, $0.36 f_c'$. Maximum diagonal tension is 120 psi, or $0.044 f_c'$. It was assumed that the concrete will carry $0.3 f_c'$ and that the reinforcing steel will carry the remainder.

Temperature stresses are negligible. In Cuba the temperature ranges from a minimum of 60 deg F to a maximum of 95 deg F, with a mean annual reading of 77 deg F.

Prestressing and post-tensioning

Five transverse diaphragms, 8 in. thick and spaced about 50 ft apart, support cast-iron saddles for the cables. Under and over these and at the pier saddles, the 28 main cables are held to design position. These Roebling galvanized cables are $1^{11}/_{16}$ in. in diameter and 372 ft long from anchor to anchor. To assist in providing full restraint for the main span, 16 Roebling cables of $1^{9}/_{16}$-in. diameter were placed in the top slab over the piers. These cables vary in length from 48 to 104 ft (Fig. 4).

Bonding was prevented by passing the cables through thin metal tubes of $6^{1}/_{2}$-in. diameter cast in the side spans, and by wrapping the slab cables in paper. Two coats of asphaltic paint protect the entire length of each cable. At each end of the side spans, the bridge is anchored to rock by eight cables of $1^{9}/_{16}$-in. diameter (Fig. 2).

The designers did not overlook the advantages of bonding the cable strands to the concrete. However, experience with prestressed concrete bridges in Cuba was limited to three previous structures: Cañas, of 249-ft clear span, built in 1952; Agabama, of 131-ft clear span, built in 1953; and Arimao, of 200-ft clear span, built in 1954. It was decided, therefore, to keep the cables unbonded at least for 6 months after construction, at which time their tension would be rechecked. The behavior of the structure and the materials composing it during the elapsed time would contribute to a decision as to whether or not the cables should be bonded.

An unbonded design is more flexible and allows the designer to check the actual stresses in the concrete and the steel at any moment. Further, unbonded strands and prefabricated elements usually contribute to faster and better construction. Another consideration was that an unbonded design would permit the load carrying capacity of the bridge to be increased at a later date if necessary.

In accordance with this plan, the strands were rechecked in December 1954, about 5 months after the first tension was applied. Average losses were found to be about 16.2 percent. Then the strands were retensioned up to 160,000 psi to perform a partial test of the bridge. The bridge was kept in this condition for about two months, and in March 1955 the strands were finally adjusted to the working stress condition. It was found that losses were 7.5 percent, and also that, as a general trend, slab-strand losses were slightly higher than main-strand losses.

It was decided to leave the strands unbonded, and to recheck the tension periodically to learn more about the behavior of prestressed concrete structures. The same plan will be followed on the other bridges of this type built in Cuba.

The bridge is fully prestressed, having compressive stresses at the bottom of the center section with full live load applied. The minimum ultimate tensile strength of the prestressing steel is 240,000 psi. In the main span, the design prestressing is 130,000 psi; in the slab and the anchors, 120,000 psi. Initial prestress in the cables was 140,000 psi to allow for relaxation and creep.

When the vertical anchor cables at the ends of the side spans were prestressed, the stress was limited to half that required by dead load alone, making the bridge a statically determinate structure. Then the secondary steel hinges were adjusted and fixed and the hold-down cables were stressed up to their full working tension. Under dead load plus live load, the bridge is a statically indeterminate structure.

Thin concrete curtain walls connecting the piers with the breast wall enclose the space beneath each side span. The anchorages for the cables at each end of the bridge are contained in a cable chamber behind the breast wall. Access to the interior of the hollow girder is through two tunnels cast into each side span and through openings which were left in each diaphragm.

Construction sequence and falsework

Although the bridge was built during the dry season, provision was made to permit safe passage of flood waters during construction. The falsework supporting the forms for the central span was designed to consist of four wooden towers and, in the deepest part of the river, one steel-tube pile bent. These falsework supports were located about 50 ft apart, center to center, so that

Main prestressing cables pass through solid end spans of bridge in thin metal tubes of $6^1/_2$-in. diameter to prevent bond. In photo at far left, these tubes are seen in place for one end span. In each of two cells of box girder, which forms center span of bridge, 14 prestressing cables are held in design position by diaphragms supporting cast-iron saddles, as shown in two nearer photos. An opening through each diaphragm provides access.

→

Falsework supports were located about 50 ft apart on centers, so that steel beams 43 ft long could span clear distance between them. Four wooden towers, and one steel-tube pile bent in deepest part of river, were used.

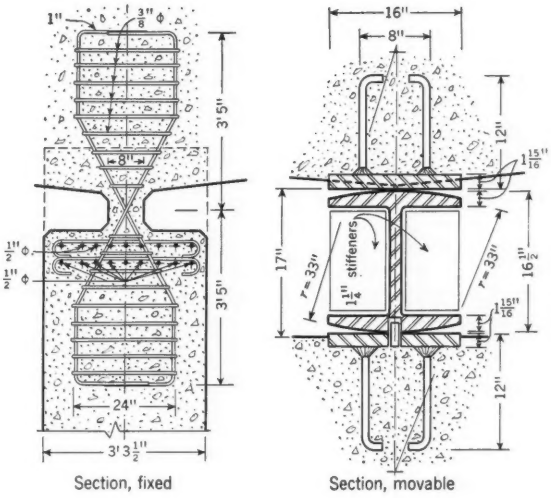
steel beams about 43 ft long could span the clear distance between them.

Plywood forms were used. The pouring sequence was as follows. The side spans were poured first, with the thin metal tubes for the 28 main cables and the 16 slab cables in place. Next, the bottom slab of the hollow box girder was poured. Then the concrete for the vertical walls and the diaphragms, with the cast-iron saddles in position, went into the forms. Finally the top roadway slab was poured. All construction joints in these elements were vertical. The main cables were laid in place after the concrete box girder was finished. Cables were passed through the metal tubes in the side spans, and under and over the cast-iron saddles.

Construction was begun in December 1953, completed in July 1954, and the bridge was opened for traffic in November 1954.

Including the falsework and anchoring, the total cost of the superstructure for the Rio Cuyaguateje Bridge was $179,723.86 (U.S. dollars), or $15.50 per sq ft of deck.

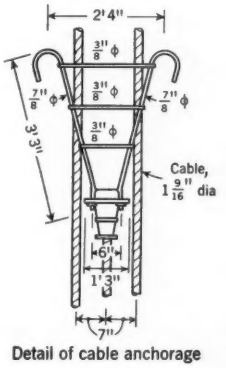
The bridge was designed by the authors for the Comisión de Fomento Nacional de Cuba. The contractor was Ing. Fernando Munilla; the resident engineer, Ing. Gustavo Rutzen. The authors acknowledge with thanks the helpful advice of H. K. Preston, Jr., A.M. ASCE, bridge engineer with the John A. Roebling's Sons Company, concerning details of the strands.



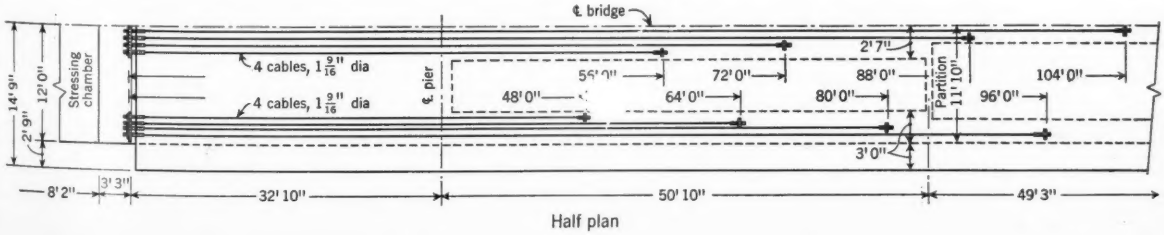
Section, fixed — Section, movable

FIG. 3. Fixed end of main span rests on continuous reinforced concrete hinge of Mesnager type, illustrated at left. Movable end rests on three 3-ft steel rockers, shown at right.

FIG. 4. To assist in providing full restraint for main span, 16 prestressing cables were placed in roadway slab and extended over each pier. These cables vary in length as shown in half plan, below. Where a cable terminates in roadway slab, it is anchored by hooked reinforcing, as shown in detail at right.



Detail of cable anchorage



Half plan

ENOCH R. NEEDLES, President of ASCE

Howard, Needles, Tammen & Bergendoff, Consulting Engineers, New York, N. Y.

PROBLEMS THAT CHALLENGE OUR PROFESSION

as outlined by incoming President in inaugural address at Annual Convention

In over forty years of civil engineering practice I have seen many epoch-making developments in civil engineering and construction. A major one came as a result of experience on the great construction projects of World War II. The biggest lesson learned from these for peacetime was the value of coordination and cooperation—the feasibility of using ten engineering and contracting organizations to produce a 100-million-dollar project in the same time as one such organization could produce a 10-million-dollar project, all ten parts being integrated into one huge construction project of unprecedented proportions.

My closest contacts have always been in matters pertaining to transportation. A revolutionary development in this field—in financing, engineering and construction—has come upon us in the past ten years, since World War II. I refer of course to the modern toll expressway, built through the sale of revenue bonds and paid for only by the user. This has proved to be romance, adventure, and opportunity for the civil engineer and builder all rolled into one.

After World War II in 1946 we had about 30,000,000 registered motor vehicles. Today we have about 61,300,000, and the motor industry is one of our giants. Because of high costs and greatly limited funds, the highways in general have remained of 1942 vintage. Thus, through dire necessity and public acquiescence and later support, has come the modern toll expressway, built in complete units and paid for only by the user.

In 1947 the toll roads in use were the original section of the Pennsylvania Turnpike and the Merritt Parkway. As of today, some 18 states have turnpikes in use, under construction, or financed, or established as feasible. The total of these is about 3,430 miles, with a total cost of about $4,835,000,000. Truly, these have been revolutionary developments, clearly beyond all prophesy.

Now, what is ahead in years to come for the civil engineer and the builder? An unbridled imagination may prove more accurate in visualizing the future than any forecast based mainly on reason.

What part will research play in determining our future, and in what fields will research prove most productive for builders? No dogmatic answers are possible, but we have some stubborn problems and some old conditions which have been with us in some form for generations. Transportation into and out of our major metropolitan areas is becoming increasingly difficult and baffling, whether we consider New York, Chicago, or Los Angeles. For generations, the gage of a railroad track has been 4 ft $8^1/_2$ in., with one basic type of road bed. Will this always be so, together with all that it implies?

What will be the answers to our smog problems? When and how will we end the corrosion of structural steel? What will the wearing surface be for our highways of the future, and will such surfaces be truly permanent? Will our future water supplies come from other sources than rainfall? Will there be new provisions for disposal of waste, both domestic and industrial? How fast will we travel? How safe will the journey be? And how quiet and dependable?

Each question we ask prompts others. I ask these questions not to baffle, but to picture in part what the brilliant future of living may become, and what a great and vital part in that future the civil engineer will occupy.

My optimism has a sound basis. When we build, we do so with men, materials, tools and harnessed power. We are rapidly moving into the age of nuclear fission. So far as power sources are concerned, never before has man been so wealthy. We dare not limit our thinking as to how our expanding multitude of power sources will be adapted to the use of man and how his living will be affected. The chemistry, physics, and electronics of the future will certainly be productive of more new materials and processes. We can be certain that our construction equipment and methods will be different and better. We can be certain that our engineers and our engineering techniques will continually improve. Some of our future structures may appear fantastic in terms of present concepts.

In adapting new materials to construction, could it be possible that some day we may be using a concrete with a new type of cementing agency? Is a plastic type of cement a possibility? Will materials yet to be developed greatly reduce or practically eliminate expansion and contraction joints and temperature stresses? Is it possible that glass fibers or some other form of glass may provide usable structural elements offering high tensile strength, complete resistance to corrosion, and other advantages?

Will we begin to see realized our often-dreamed-of elevated tunnels or tubular sections to carry the future rapid transportation facilities of metropolitan areas? These tubes would be above the street level, would pass through buildings, cross over streets at mid-block, and thus would conserve the light, air, quiet and beauty of our cities. Access to and from these tubes would be from within the buildings which they serve.

What will our great national highway system be like in future years? How soon will Congress permit a real start on this system, now so long overdue? From a purely business standpoint, what interests could possibly derive greater monetary benefits from this program than the trucking, oil, rubber, and motor manufacturing industries which have opposed this program in the past?

My optimism for the future of our Society and of the civil engineering profession is unbounded. Our history, our traditions, and our service to our fellow men in past years have given us great reason to be proud. As we pursue our researches and learn more about the problems of providing the structures and facilities needed for our people in the future, we will be faced with ever-new challenges and, as our responsibilities increase, our solutions to these new problems will enable us to be even more proud.

Pickup beams carry 600-kip column load in underpinning job

E. L. SCRUGGS, M. ASCE

Vice President and Chief Engineer, The Springs Cotton Mills, Lancaster, S.C.

In making plans for an extension to the Grace Bleachery of the Springs Cotton Mills, Lancaster, S.C., it was found that five footings, carrying the columns on the outside wall line of the old building, would have to be carried down approximately 16 ft deeper to get them below the excavation for J-box pits which were within 4 ft of the column line. See Fig. 1.

The load on the single columns was approximately 75 tons each. One of the footings carried a double column, where an expansion joint occurred. It was necessary to do all the shoring parallel to the building wall since machinery was located so close to the old wall line that no shoring could be done within the confines of the old building.

The Underpinning and Foundation Company of New York City, which had done a similar job for the Springs Cotton Mills, was called into consultation and designed the scheme which was successfully carried out. The sequence of operations was as follows:

Step 1. Work was started at El. 520±. Long pits were excavated and sheeted to El. 513 to expose the footings.

Step 2. Pits for temporary pickup footings were excavated and sheeted to El. 504±.

Step 3. Concrete pickup footings were placed and carried up to El. 511±.

Step 4. A timber crib of 12 × 12's was placed.

Step 5. This step was carried out in three operations. First the cut through the concrete pedestal was

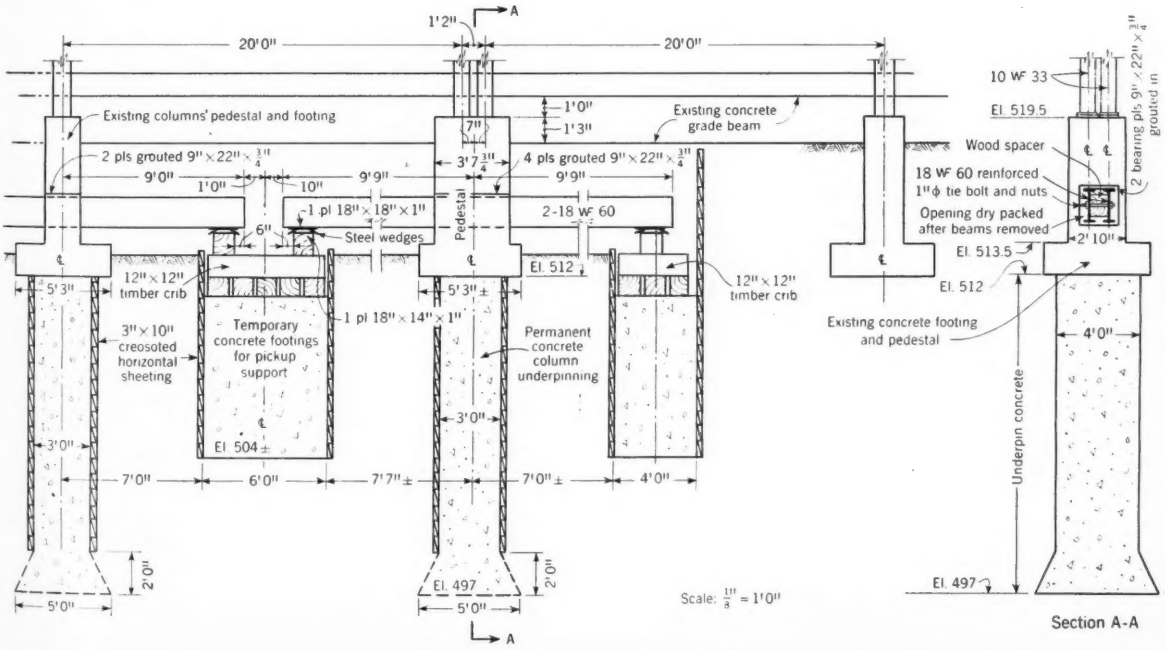
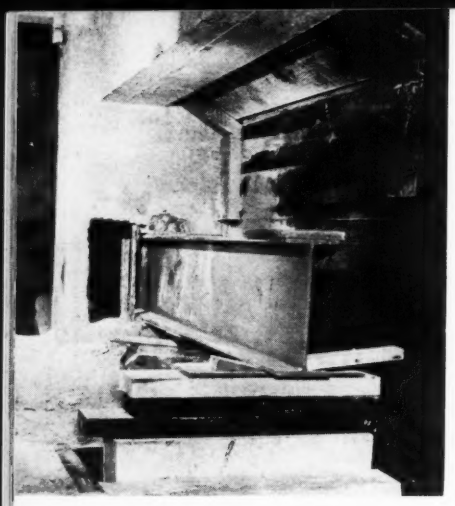


FIG. 1. To carry existing concrete footings down 16 ft along building edge, where machinery required all shoring to be done parallel to building edge, temporary concrete footings, support ing two pickup beams, were put down 9 ft.



Two needle beams, or pickup beams (18 WF 60), were put through reinforced concrete columns to take load on temporary footings until permanent footings could be extended 16 ft below their original position.

made to receive one of the 18 WF 60 pickup beams, plates were set in, and concrete placed. In the second operation the same work was carried out for the pickup beam on the other side. In the third operation, spacers and tie rods were put in position for the two 18 WF 60 beams.

Step 6. The load was transferred to the pickup beams by screw jacks bearing on the temporary footings. The load was then transferred from the jacks to the cribbing by plates and wedges.

Step 7. Underpinning pits were excavated and sheeted from El. 513 to El. 497.

Step 8. Underpinning concrete was poured, and the pedestal bearing was dry packed between the new concrete and the existing footing.

Step 9. After the dry pack had set, the pickup steel was removed.

These steps were performed concurrently for alternate columns.

Stability chart for designing earth slopes

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To design an earth slope or to investigate its stability, a chart can be very helpful. The chart shown in Fig. 1 gives the relationship between the shearing strength of the soil and the factor of safety against sliding for a fixed earth slope. The chart is especially useful where shearing-strength values are uncertain or vary because of changes in soil conditions. The influence of different combinations of the soil-strength values of cohesion and angle of internal friction on the stability of a particular slope can be determined directly from the chart.

For any earth slope, with the seepage conditions and density of the soil known or assumed, the stability chart may be constructed without the use of the values of cohesion and the angle of internal friction. Therefore, no repetition of the tedious process of stability analysis of the slope is needed when the slope is to be investigated for stability based on different shearing-strength values.

Using the Swedish circular sliding surface method for the stability analysis of earth slopes, the following equation for the factor of safety, F_s, may be written:

$$F_s = \frac{cL + \tan\phi\, \Sigma N}{\Sigma T} \quad . \quad . \quad . \quad (1)$$

in which

c = cohesion per unit area
ϕ = angle of internal friction of soil
L = sliding surface area expressed in arc length per unit width
ΣN = summation of normal forces of all the slices
ΣT = summation of tangential forces tending to produce slide

For any trial circular surface, ΣT, ΣN and L are constants; or F_s varies with any combination of c and $\tan\phi$. For any assumed value of F_s, Eq. 1 is a straight line and may be plotted by intercepts, that is:
For $c = 0$,

$$\tan\phi = \frac{F_s \Sigma T}{\Sigma N} \quad . \quad . \quad . \quad . \quad (2)$$

For $\tan\phi = 0$,

$$c = \frac{F_s \Sigma T}{L} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

One trial arc determines one straight line for a chosen value of F_s. A set of straight lines are thus obtained from the analysis of a number of trial arcs for the same F_s value. The envelope of the straight lines determines the required combination of c and ϕ for the critical sliding surface to give the fixed factor of safety.

The chart is completed by repeating the same process for other factors of safety.

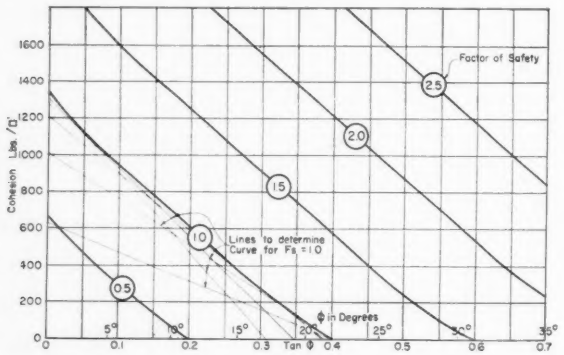
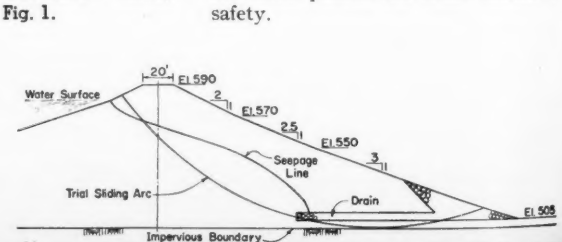


FIG. 1. Stability chart for various factor-of-safety values is drawn for varying slope as shown in Fig. 2.

TRIAL NO.	ΣN lbs.	ΣT lbs	L feet	Fs=0.5 C=0 tanφ= 0.5ΣT/ΣN	Fs=0.5 φ=0 C= 0.5ΣT/L	Fs=1.0 C=0 tanφ= ΣT/ΣN	Fs=1.0 φ=0 C= ΣT/L	Fs=1.5 C=0 tanφ= 1.5ΣT/ΣN	Fs=1.5 φ=0 C= 1.5ΣT/L
1									
2									
3									
4									
5									

FIG. 2. Varying slope for a dam is used as basis for illustrative chart, Fig. 1.



Improvised test cart applies 10,000-lb wheel load

BENJAMIN G. SCHREINER, Chief, Field Operations for Research Projects, Flexible Pavement Branch, Soils Division, Waterways Experiment Station, Corps of Engineers, U.S. Army, Vicksburg, Miss.

The Waterways Experiment Station, Vicksburg, Miss., was assigned the problem of developing design criteria for landing mats and flexible pavements for various wheel loads and tire pressures in 1951. These design criteria were to assure the most efficient use of landing mats and flexible pavements in forward areas. One of the wheel loads selected for use in applying accelerated traffic to develop these criteria was 10,000 lb on a single wheel with tire pressures of 40, 100, 200, and 300 psi. This load in general bracketed traffic conditions imposed by fighter and light cargo planes.

A test-load cart was improvised from an old Athey wagon chassis, with different axles constructed to fit wheels carrying tires suitable for the inflation pressures listed above. Several types of towing vehicles were tried for towing this test cart, such as rubber-tired farm tractors, D-4 caterpillar tractor with strut plates, and M-29 Weasel. The conformation of these vehicles was such that it was impractical to drive the test cart backward. Consequently, it was necessary to turn at each end of the test lane and drive forward in both directions. For the short test lanes used in connection with the test program, this meant that about two-thirds of the traffic and construction cost was expended on the turnaround areas. It was also noted that more than half the wear on the high-pressure tires occurred on the turnaround areas. Some of the tires were not readily replaceable; therefore, it was considered expedient to find or develop a piece of towing equipment that would maneuver the load cart satisfactorily both forward and backward.

Peter G. Rae of the Operations Division, and the writer, both connected with the Waterways Experiment Station, conceived the idea of utilizing the front end of a $2^1/_2$-ton truck equipped with front-wheel drive and an Athey wagon frame to provide a self-powered load cart. After obtaining the necessary authority, a badly worn truck was selected. Its frame was cut through just back of the transmission, and essential repairs and alterations were made.

The truck was then fitted to the Athey wagon frame so that the connection between the truck and the wagon chassis could be adjusted to keep the load cart on a level plane when tires of different sizes were used. The front wheels of the load cart were equipped with 10.50–18 high-flotation tires maintained at an inflation pressure of 16 psi. The load on each of the front wheels was about 1,000 lb after some weight had been added to improve traction. The low-pressure tires and light load made the effect of the driving wheels of the rig negligible in evaluating test results. One of the accompanying photographs shows the cart equipped with small 24-5.5 high-pressure tires inflated to 300 psi. The other photograph shows it equipped with 17.00-16 low-pressure tires inflated to 40 psi. Pertinent data regarding the tires used are given in Table I.

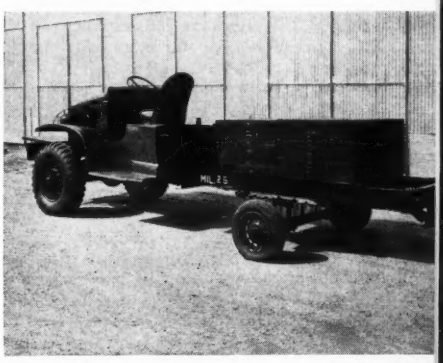
The test-load cart has the maneuverability of the original truck, and is capable of applying traffic more rapidly and accurately than any previous type of equipment used. This cart has been in use at the Waterways Experiment Station for the past three years in simulating airplane traffic in connection with test programs for the development of design criteria for landing mats and flexible pavements. It has also been used on special tests of asphalt pavements at Eglin Air Force Base, Florida, and Pope Air Force Base, North Carolina. Plans are now being made to reproduce the load cart for accelerated traffic tests at Wolters Air Force Base, Texas. The Engineer Board has also indicated an interest in this equipment.

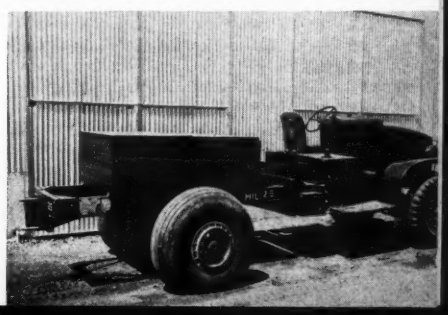
The new load cart has greatly accelerated the traffic tests and resulted in achieving more accurate, thorough, and complete coverages than previously accomplished with any of the former trailer-type equipment. Thus, better test data and considerable savings in time and money are obtained in the conduct of the test programs.

TABLE I. Data on tires used to apply 10,000-lb wheel load, with varying inflation pressures, to test landing mats and flexible pavements

Inflation Pressure, psi	Tire Size	No. Ply Rating	Contact Area, sq. in.	Contact Pressure, psi	Deflection of Tire, %	Total Length of Tire Print, in.	Max. Width of Tire Print, in.
40	17.00–16	12	248	40	32	21.1	13.4
100	34–9.9	14	91	110	26	13.8	8.4
200	26–6.6	12	53	190	35	11.0	5.8
300	24–5.5	14	39	256	31	10.1	4.9

Test-load cart was improvised by attaching front end of old $2^1/_2$-ton truck equipped with front-wheel drive to Athey wagon frame so that connection can be adjusted to keep cart level when tires of various sizes are used. In upper view cart is equipped with 24-5.5 high-pressure tires inflated to 300 psi. In lower view tires are 17.00-16 low-pressure, inflated to 40 psi.





THE READERS WRITE

Method of reporting teachers' salaries questioned

TO THE EDITOR: The 1955 Report of the ASCE Committee on Salaries, as outlined in the August 1955 issue (p. 50) indicates that some improvement has taken place since the last survey, especially for more experienced men. Whether some of these increases are "real" or only "paper money" may be judged from the method used in computing annual salaries for engineers engaged in teaching in universities. The report says (p. 50):

"Salary data deal only with payroll rates, with no adjustment to correlate data on the basis of a standard number of hours of work per week. However, in teaching, where the term is less than 12 months, reported annual salaries have been adjusted upward to the 12-month equivalent on the assumption that vacation income will be at the same rate as the salary during the teaching period."

These are rather dangerous assumptions. Why should employees of industry have no upward adjustment for working less than the standard work period, while professors receive fictitious salaries on the assumption that they work full time during "vacations" at the same rates? A professor who teaches in his own college during the summer usually receives only a fraction of his rate. In addition, professors usually put in more than a 40-hour week because of the work they take home regularly. In my experience the average engineering professor does this more frequently than does the average industrial engineer of my acquaintance. Moreover, it seems to me that a statistical study should not adopt such an unscientific device as "upward adjustment" of salaries without having more information than appears in the article.

It is true that, in the summer, some teachers earn as much as, or more than their academic salary rate, but there are many who cannot or do not. Those who find employment in another city may spend a large part of their earnings on temporary living quarters and be separated from their families for three months. Others may do research at their universities, but they may or may not receive any compensation, depending on whether such research is sponsored or not. Some will attend the ASCE or other conventions and take a short vacation—all of this time being charged up to them in the "upward adjustment." Notice also that academic salaries in general are not (yet) favored with "fringe benefits" to the extent that industrial salaries are—at least not to my knowledge.

I do not charge that any deliberate attempt has been made to make the engineering professors appear better off than they are. But there seem to be efforts outside the profession tending to exaggerate spending on all education (especially tax-supported) and attempts to keep budgets "within limits" (meaning as low as possible).

The long period of educational training and apprenticeship in teaching, usually delayed by two years of military service, eventually leads to an appointment at less salary than a comparable position in industry. Moreover the average work week in industry has decreased over 25 percent in the past 40 years, but labor-saving machinery does not seem to cut the hours at the universities. Is it any wonder that there is a scarcity of qualified engineers who want to teach?

It is heartening to observe that Harvey O. Banks, M. ASCE, in his article, "Engineering Education Is Every Engineer's Business," emphasized in the same issue of CIVIL ENGINEERING (August, p. 55) that an adequate salary scale is needed to attract and hold a competent faculty. He stated that the 1952 salaries of full professors—when adjusted for cost of living—were 12 percent lower than they were in 1941–1942, while industrial workers were up 55 percent. (This says nothing about sharing in the increased productivity of the nation at 2 to 3 percent a year.)

In conclusion, it behooves the Society to exert strong efforts to strengthen the faculties of the engineering colleges by improved salaries and laboratory facilities in order that industry and public agencies may be able to recruit well educated young men for replacement and growth. Salaries which have been "adjusted upward" give a distorted view of the real situation.

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Columbus, Ohio

The Committee on Salaries answers

TO THE EDITOR: The Committee on Salaries has long realized that the method used in reporting teachers' salaries is by no means perfect. No rule of thumb or common yardstick can be applied with the hope of obtaining an absolutely true picture of the situation where members of the group receive their annual salary based on anywhere from 9 to 12 months of actual service. On the other hand, the present and previous committees have always felt that reporting the salaries directly under these circumstances was even more misleading and that some adjustment was necessary to put everyone on an equal basis. This would hold true not only in comparing the income of teachers with that of other groups within the profession but also in comparing the salaries of teachers within their own group, where the payment is for different lengths of time.

There certainly has been no intent to present a false picture. In each survey report the committee has been careful to explain the basis used in reporting teachers' salaries so that everyone making use of the report would realize that an adjustment had been made, and the nature and extent of this adjustment.

The committee is not satisfied that it has the best answer to this problem. Actually, it has been dissatisfied with the arbitrary method used but to date has not been able to arrive at any other method which, in its opinion, would give a more accurate result. The problem was discussed in some detail at the August 1955 meeting of the Committee on Conditions of Practice, in Milwaukee. Although the members of the teaching profession represented on this committee expressed some dissatisfaction with the method of adjustment used, the only worthwhile alternative brought forward at that time was Dean Dawson's suggestion that 11/9ths be considered by educators as a more satisfactory upgrading factor than 12/9ths, when adjusting for a nine-month year of required service.

The Committee on Salaries has placed the method of reporting teachers' salaries on the agenda as one of the principal items for consideration before the next survey is published. It is hoped that during that interval a method will be selected which will provide for more accurate reporting and be acceptable to the teachers. The committee will welcome any suggestions along this line.

ROBERT J. ELLISON, M. ASCE
Chairman, Committee on Salaries
St. Paul, Minn.

More on solution for circular arc and area of segment

TO THE EDITOR: In his letter in the October issue (p. 114) Mr. Bates challenges a statement in my letter in the August issue (p. 65). Adhering strictly to the rules of trigonometry, the statement challenged by Mr. Bates,

$$A = \text{area of sector } AOB - \text{area of triangle } AOB$$

applying directly to (*a*) of the accompany-

ing Fig. 1, holds equally true for (*b*) of this Fig. 1 if the triangle *AOB* in (*b*) is regarded as a "negative area." The final formula

$$A = {}^1/_2 R^2 (\theta - \sin \theta) \ldots\ldots (a)$$

automatically takes care of the case when $\theta > 180$ deg, since sin θ is then negative, thus causing the numerical quantities in the parenthesis to be added. Therefore no separate derivation is needed for this case.

As to the proposed simplified Eq. 3, it in reality becomes

$$A = {}^1/_2 R^2 (K\theta - \sin \theta) \ldots\ldots (b)$$

Introduction of the constant K appears to be an unadvantageous complication for two reasons: (1) the ordinary table of natural (or log) functions is accompanied by a table converting degrees into radians; and (2) degrees can be converted into radians if multiplied by $\pi/180$.

Example: Given $R = 300$ ft, $\theta = 212°42'$, to find area of segment.

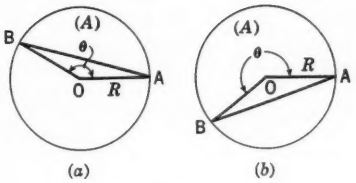

FIG. 1

Solution: sin $\theta = -$ sin $32°42' = -0.54024$.

By Eq. (*a*), $212°42' = 212.7° = 212.7 \times (3.1416/180)$ radians $= 3.71232$ radians.

Then $A = {}^1/_2(300)^2(3.71232 + 0.54024) = 191{,}365$ sq ft.

By Eq. (*b*), $212°42' = 12{,}762$ minutes.

Then $A = {}^1/_2(300)^2[(0.0002908882)(12{,}762) + 0.54024] = 191{,}365$ sq ft.

T. F. HICKERSON, M. ASCE
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A plea for higher status, to be won through cooperation

TO THE EDITOR: I have read with much interest the articles and letters in recent issues that discuss engineering education and collective bargaining. They offer criticisms and possible solutions of some phase of the over-all problem faced by the entire engineering profession.

Most engineers recognize that the professional status accorded engineers is not nearly as high as it could or should be. There are many opinions among engineers as to how this could best and most rapidly be reached. As a young engineer, I believe the solution can best be formulated by the older engineers, the very ones who would stand to benefit the least in terms of tangible gains from the application of this solution. The reason these older, more experienced engineers must take the lead in working out a solution is that they are the ones who best know the shortcomings and needs of the profession.

This doesn't mean that the young engineer can sit back, relax and wait to enjoy the fruits of this program. On the contrary, any program to improve professional standards must have the overwhelming support of the great majority of engineers. If most engineers are not interested in raising their professional status, that status can go nowhere but down, much to the delight of labor union leaders who seem to look upon engineers as a vast group of potential dues paying members. The young engineers must, in effect, do the legwork, take an active interest in the program, give full support to the engineering societies, and improve themselves professionally; in short, they must raise their own standard so that that of the society as a whole will go up.

This raising of professional standards will accomplish several things. First, salaries will begin to go up as employers realize that a man is an engineer, not a technician, and is capable of doing responsible work. This raising of salaries without resorting to collective bargaining, which means really a labor union, will enable engineers to keep their professional status intact. Second, the extra years of schooling required for a strong program of this sort would serve as a deterrent to capable young men considering engineering as a career unless they considered the professional prestige and monetary returns after graduation to be worth the extra effort. A medical student eagerly looks forward to his eight or more years of training because he knows what is waiting at the end of the line.

As the new engineers begin to graduate from the improved engineering colleges with a much better knowledge of engineering and social sciences, with the ability to think and reason and with a pride in their profession, the professional status (and salary) of engineers could go nowhere but up.

The obvious course now seems to be one of agreeing on a program and taking positive action on it as soon as humanly possible. The program at this time may be only one of compromise, but once put into effect, it can then be improved.

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Calif. Div. of Highways
San Leandro, Calif.

Tests needed to determine stress-loss factors

TO THE EDITOR: In their article, "Method Presented for Computing Steel Prestress Losses," p. 62 of the August 1955 issue, Messrs. Stephenson and Jones present a general formula for computing the stress losses. They have clearly identified the several losses, namely, shrinkage, elastic strain of concrete, creep of concrete, and steel relaxation, and incorporated these into a definite relationship. Several of the variables which influence shrinkage and creep characteristics of concrete are indicated, and specific values and coefficients are set forth for computing the resultant strains in the prestressed concrete and steel.

I believe that in their effort to simplify the problem of predicting loss in prestressing, the authors have omitted several important factors and have overly restricted the range of certain suggested values. Omitted from their list of controllable factors affecting concrete shrinkage is that of dimension of the prestressed member. Not only is the rate of shrinkage greatly reduced by thickening a section, but the total shrinkage appears also to decrease. The values of ultimate shrinkage recommended by Leonhardt and presented by the authors, namely, 200 to 300 millionths of an inch per inch, seem lower than one might anticipate for concretes containing, for example, 8 sacks of cement per cu yd and between 250 and 300 lb of water per cu yd of concrete. For such concretes, Blanks, in the *Proceedings of the First U.S. Conference on Prestressed Concrete*, suggests values of from 350 to 550 millionths of an inch per inch, based on tests performed at the Bureau of Reclamation. In the same *Proceedings*, Dobell suggests values in the range from 300 to 650 millionths, for high-strength concretes.

In their discussion under "Deferred Strain in Concrete," the authors cite Leonhardt's recommendations of a factor from 2.0 to 2.5 times the elastic shortening of the concrete in computing ultimate concrete creep. Blanks suggests 0.5 to 1.5, and Dobell indicates values ranging from 250 to 650 millionths of an inch per inch creep for concrete stressed from 1,000 to 2,000 psi. It would appear that there certainly is nothing approaching unanimity as to which factor to use in computing concrete creep.

Actually, relatively little long-time creep data have been developed for high-strength concretes stressed to levels encountered in present-day prestressed structures. It is generally agreed, however, that creep is most directly related to strength of the concrete. It is surprising, therefore, that concrete creep is expressed as a function of the elastic modulus of the concrete. In a study of several normal-weight aggregates at this laboratory, the statically-determined elastic moduli of two concretes of identical cement content and compressive strength were

observed to vary between 3.78×10^6 psi and 5.95×10^6 psi, depending on aggregate source. If the formula suggested by the authors,

$$U_d = 2.5 f_{ci}/E_c, \text{ where}$$

U_d = unit strain in concrete due to creep
f_{ci} = initial unit stress in the concrete
E_c = modulus of elasticity in concrete

were applied to the above concretes of differing elastic moduli, one must conclude that the more rigid specimen would display

$\frac{5.95 - 3.78}{5.95} = 36.5$ percent less creep than the less rigid concrete, when subjected to the same unit stress

I am not aware of any data that would substantiate such a conclusion.

There are two other important factors affecting concrete creep which are not mentioned by the authors. Blanks points out in the above mentioned *Proceedings* that for specimens of the same concrete when stressed to 1,000 psi for $1^1/_2$ years, the creep varied from 210 millionths (for a 10-in.-dia cylinder) to 350 millionths (for a 6-in.-dia cylinder). It would appear that the selection of cross-sectional dimensions in the member would influence the amount of creep in the concrete. Added to the authors' list of concrete properties influencing creep should be aggregate gradation. Lorman, in the *ASTM Proceedings*, Vol. 40, presented evidence showing that aggregate gradation ranks with mix proportions in its influence on concrete creep.

The uncertainty and contradictions that are evident when examining the various recommended stress-loss factors should not reflect on the authors. It is only with data obtained from carefully planned and executed field and laboratory tests that the present confusion can be resolved.

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Port Hueneme, Calif.

Junior Members comment on unionization

Four papers on "Unionization and the Young Engineer" were presented by Junior Members of ASCE in competition for the Daniel V. Terrell Award of District 9. The winning paper, "Unionization—a Vital Question Awaits an Answer," by Baxter W. Napier, Jr., was published in the September issue, p. 42. This paper is here discussed by two of the runners-up for the award.

TO THE EDITOR: Mr. Napier has very capably presented the complex problem of unionization, which faces the entire engineering profession. A few of the facts presented in his article are worth repeating.

The major causes of dissatisfaction among engineers are: (1) unprofessional treatment, and (2) low pay. It is evident therefore that what the engineer wants is to be recognized as a "professional man" and to obtain a salary in accordance with that recognition. In the past, and at present also, the status of the professional engineer has too often been taken for granted. This attitude on the part of many people, perhaps, is the root of engineer dissatisfaction, and a prime cause of the recent cry for formation of bargaining groups to "protect" the engineer.

Now a bargaining group to be of value must be capable of satisfying the engineer's desires. Recent successes of the labor union movement indicate the ability of the union to obtain better pay conditions. Indications are, however, that recognition and professional treatment are classed as more important from the standpoint of the engineer. Can recognition be demanded? The answer to this question is rather self-evident and in the negative.

Recognition, as such, for the engineer will not be granted more freely until there is a greater understanding of "professionalism." The public must come to appreciate more fully the desires, abilities, and nature of the engineering profession. The attitude of the engineer that "behind-the-scenes" activity is desirable must be changed. Let the people know exactly who is doing the work, the results of which are so evident around us. Until one notion—that the administrator or manager is the great productive force in this profession—is changed, engineers will always face the same causes of dissatisfaction. Let us give credit where credit is due, and not be shy about taking credit for a professional job well done.

The education contemplated, and it certainly is education, can readily be handled by existing organized or technical societies. Let these societies emphasize, through the various mediums of communication, the engineering projects, active in their locale, as well as the professional men associated with the work on these projects. Let us attempt to place the names of the professional workers on the plaques associated with monumental structures. Let us promote the professional use of the professional man and thus most efficiently utilize his capabilities. Finally, let us start on a major attempt to introduce the people to the nature of engineering and the engineer. Minor attempts have been made before, but this time we should make a concerted effort.

I firmly believe education as described above provides the answer to the dissatisfaction of many engineers. With recognition comes contentment, and with contentment comes productiveness and the closely associated matter of adequate pay. The solution to the problem of unionization is available if we have the strength and conviction to carry it through successfully.

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TO THE EDITOR: Mr. Napier's article again presents the startling fact that 43 percent of those Junior Members responding to a recent questionnaire from ASCE were not opposed to collective bargaining. This seems to me to be serious because all the arguments put forth to date are in reality much stronger for unionism than for collective bargaining, and I have the feeling that what those engineers mean is that they are not opposed to unionism.

Surely they must realize that to be successful such an organization must operate on the same principles which the present trade unions have found so effective, that of subordinating the actions and programs of the organization to the needs of the weakest member because such people, having the most to gain, are the strongest supporters of the movement. Even a collective bargaining unit composed of engineers would soon succumb to such a leveling influence.

We have in the American Society of Civil Engineers an organization capable of providing all the good features of unionism without exposing us to the dangers of a union type of organization, if we will just support it in the manner in which a union would have to be supported to be effective. A closely knit nationwide organization is potentially much more effective than isolated bargaining units. Another advantage which we possess, incongruous with union philosophy though it may be, is that ours is a society composed of both employees and employers and as such should be of as much benefit to one as to the other.

One of the most frequent reasons given to support the need of bargaining units is the inequalities in pay received by engineers and those represented by bargaining units. If the employer members of the Society can be made to realize by the employee members, acting through the Society, that unless some voluntary adjustment of salaries is made they will force their employees to unionism, I feel certain that just compensation will be forthcoming as well as proper recognition of work well done and reasonable advancement.

Both classes of engineers are represented in sufficient numbers in our society so that their actions would be reflected throughout the profession. For this reason, we are obligated, and privileged, to develop a program within our existing organization without coercion from either employer or employee groups—but fair and equitable to both.

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Planning Engineer
McDowell Company, Inc.

Cleveland, Ohio

AMERICAN SOCIETY OF CIVIL ENGINEERS

Dallas Convention

Texas Section, Host

Dallas, Tex. **Baker Hotel** **February 13–17, 1956**

REGISTRATION

Baker Hotel, Mezzanine

Sunday, Feb. 12, 2:00 to 4:00 p.m.
Monday through Thursday, Feb. 13–16, 8:30 a.m. to 5:00 p.m.
Friday, Feb. 17, 8:30 a.m. to noon.
Registration fee, for members, $3.00. (Ladies and students are exempt from the fee.)
Special note to all Catholics attending the Convention: In view of the fact that Lent begins on February 15, a dispensation from fast and abstinence and permission to participate in the Convention festivities has been granted by the Vicar General of the Catholic Diocese of Dallas, Fort Worth.

ADVANCE ATTENDANCE INFORMATION

To assure adequate preparation to make your attendance at the Dallas Convention most satisfactory, the committee requests your assistance. It will be most helpful to have guidance in the number of persons to be expected for the various functions. Will you please use the coupon on page 104, which is to be sent to James R. Padgitt, Registration Chairman. There is no obligation attached to your use of this coupon. Your help with this advance registration will measurably facilitate the planning of the committee.

AUTHORS' BREAKFASTS

8:00 a.m. Tuesday, Wednesday, Thursday, and Friday.

Briefing sessions, by invitation, for speakers, discussers, and program officials.

Presiding: SOPHUS THOMPSON, Chairman, Technical Program Committee.

LOCAL SECTIONS CONFERENCE

English Room, Mezzanine **Baker Hotel**

9:30 a.m. Monday, and Tuesday, Feb. 13 and 14.

Representatives of Local Sections of ASCE from a selected area about the convention city will convene for discussion of expanding activities of the Society at the local level. This conference, which is primarily for invited delegates of the selected Local Sections, will be open to all who may be interested in the activities and operational details of ASCE Local Sections.

TUESDAY MORNING

FEB. 14

Air Transport Division

9:30 a.m. **Lounge Room**

Presiding: Dewey S. Wright, Chairman, Executive Committee, Air Transport Division

9:30 Some Considerations in Forecasting Air Traffic
DANIEL M. BELMONT, Associate Research Engineer, Institute of Transportation and Traffic Engineering, Univ. of California, Berkeley, Calif.

10:00 The Airport Master Plan and Its Relation to the Over-All City plan
LEIGH FISHER, Leigh Fisher & Associates, South Bend, Ind.

10:30 Expanded Federal-Aid Airport Development Program
HERBERT H. HOWELL, M. ASCE, Director, Office of Airports, Civil Aeronautics Admin., Washington, D. C.

Hydraulics Division

9:30 a.m. **Texas Room**

Program to be arranged.

TEXAS SECTION LUNCHEON

Terrace Room, 17th Floor **Baker Hotel**

12:15 p.m. Tuesday, Feb. 14.

This luncheon meeting will constitute the Spring Meeting of the Texas Section, at which time the Texas Section will honor its new life members.
Presiding: J. W. PORTER, President, Texas Section, ASCE
All members, their ladies, students, guests, and friends of the ASCE are cordially invited.
Per plate, $2.25.

TUESDAY AFTERNOON

FEB. 14

Air Transport Division

2:00 p.m. **Lounge Room**

Presiding: Dewey S. Wright, Chairman, Executive Committee, Air Transport Division

2:00 Airport Approach Protection and Zoning
S. E. TRAVIS, JR., Deputy Chief, Airports Div., CAA, Region 2, Civil Aeronautics Admin., Fort Worth, Tex.

2:45 Planning of the Kelly Air Force Base Maintenance Hangar
LOUIS A. NEES, A.M. ASCE, Chief, Eng. Branch, Installation Div., Headquarters, Air Materiel Command, Dayton, Ohio.

3:30 The Design of Non-Rigid Overlays for Concrete Airfield Pavements

FRANK M. MELLINGER, A.M. ASCE, Director, Ohio River Div. Labs., Corps of Engineers, U. S. Army, Cincinnati, Ohio.

JAMES P. SALE, Head, Soils Div., Ohio River Div. Labs., Corps of Engineers, U. S. Army, Cincinnati, Ohio.

Power Division

2:00 p.m. **Banquet Room 5**

Presiding: George I. Vencill, Member, Executive Committee, Power Division

2:00 Hydraulic Design of the Sandow Pumping Plant

R. T. RICHARDS, A.M. ASCE, Hydraulic Engr., Ebasco Services, Inc., New York, N. Y.

E. T. KECK, Vice-President, Texas Power & Light Company, Dallas, Tex.

J. JUNGET, Resident Engr., Sandow Power Plant, Aluminum Co. of America.

3:00 Use of Surface and Ground Water for Cooling Purposes for Texas Steam-Electric Stations

M. G. SALZMAN, M. ASCE, Hydraulic Engr., Ebasco Services, Inc., New York, N. Y.

WESTERN RANCH PARTY

Louann's, 5218 Greenville Ave. (North Central Expressway at Lovers' Lane and Greenville)

Tuesday, Feb. 14

6:30–7:30 p.m. Cocktails and favors, courtesy of the Texas Section, ASCE

7:30–9:00 p.m. Ranch-style meal

9:00–10:00 p.m. Fiesta, courtesy of the Texas Section, ASCE

10:00–12:00 p.m. Dancing

All members and their ladies are urged to come with a large appetite and wear their Western clothes as this party is an informal affair, and much of its success is dependent upon the atmosphere. Buses will be available for transportation from the Akard Street entrance of the Baker Hotel starting at 6:00 p.m. Be sure to secure your free transportation ticket at the time of registration. The last bus will leave the Hotel at 6:45 p.m. Return transportation will be available following the fiesta at 10:00 p.m. Per plate, $3.50. Western or street clothes.

Sanitary Engineering Division

2:00 p.m. **Crystal Ballroom**

Presiding: Ray E. Lawrence, Member, Executive Committee, Sanitary Division

Increasing Nature's Contribution to Waste Treatment

2:00 Some Design Considerations for Oxidation Ponds

EARNEST F. GLOYNA, A.M. ASCE, Assoc. Prof., Univ. of Texas, Austin, Tex.

EDWARD R. HERMANN, Research Engr., Univ. of Texas, Austin, Tex.

2:50 Fundamentals of Underground Waste Disposal

CONRAD P. STRAUB, M. ASCE, Senior Sanitary Engineer, Health Physics Div., U.S.P.H.S., Oak Ridge National Laboratory, Oak Ridge, Tenn.

3:25 Sludge Thickening at Beaumont's High-Rate Trickling Filter Plant

JOE DUST, Supt., Sewage Treatment Plant, Beaumont, Tex.

Surveying and Mapping Division

2:00 p.m. **Texas Room**

Presiding: George H. Lacy, M. ASCE

Topographic Mapping

2:00 Topographic Mapping Programs and Procedures by Topographic Div., U.S.G.S.

GERALD FITZGERALD, Chief Topographic Engineer, U. S. Geological Surveys, Washington, D. C.

3:00 Natural Resources Development's Dependence on Topographic Mapping as Part of Its Basic Data

PAUL WEAVER, Consultant, Water Research and Information Center, Texas A. & M. College, College Station, Tex.

4:00 Coordinated Surveying and Mapping for a Public Utility

E. D. MORSE, M. ASCE, Supt. of Civil Engineers, Houston Lighting and Power Co., Houston, Tex.

WEDNESDAY MORNING

FEB. 15

Welcome Session

9:15 a.m. **Crystal Ballroom**

Presiding: I. W. Santry, Jr., General Chairman

9:15 Invocation

REV. WILLIAM H. DICKINSON, JR., Assistant Pastor, Highland Park Methodist Church, Dallas, Tex.

Welcome to Texas

J. W. PORTER, President, Texas Section.

Welcome to Dallas

HON. R. J. THORNTON, Mayor, City of Dallas.

Response

ENOCH R. NEEDLES, President, ASCE.

Research Awards

General Session

10:00 a.m.

Sponsored by Department of Conditions of Practice
Presiding: Frank L. Weaver, Chairman, Department of Conditions of Practice

Panel on Aims and Attitudes of Professional Development

Moderator: Rev. Robert P. Douglass, Pastor, Preston Hollow Presbyterian Church, Dallas, Tex.

10:00 Position of ASCE Members as Relating to Professional Development

G. BROOKS EARNEST, M. ASCE, President, Fenn College, Cleveland, Ohio.

10:30 Development of Professionalism Among Lawyers

FRANKLIN E. SPAFFORD, Member, Spafford, Spafford, Hamlin, Freedman, Gay, and Russell; Past President, Dallas Bar Association.

11:00 The Medical Profession and Its Program of Professional Development

F. J. L. BLASINGAME, M.D., Member, Board of Trustees, American Medical Association, Warton, Tex.

11:30 Discussion

GOVERNOR'S LUNCHEON

Crystal Ballroom, Mezzanine **Baker Hotel**

12:30 p.m. Wednesday, Feb. 15

Address: HON. ALLAN SHIVERS, Governor, State of Texas, Austin, Tex.

Presiding: ENOCH R. NEEDLES, President, ASCE.

All members, their ladies, students, and guests are cordially invited to attend this luncheon meeting. Per plate, $2.50.

WEDNESDAY AFTERNOON

FEB. 15

Hydraulics and Sanitary Engineering Divisions, Joint Session

2:30 p.m. **Crystal Ballroom**

Presiding: Samuel R. Wright, M. ASCE

Water Supply Resources

2:30 Soil Conservation and Upstream Engineering

CHARLIE M. MOORE, A.M. ASCE, Head, Design Section Engineering and Watershed Planning Unit, U. S. Soil Conservation Service, Fort Worth, Tex.

3:00 Effect of Upstream Reservoirs on Water Supply

TRIGG TWICHELL, M. ASCE, Regional Representative, U. S. Geological Survey, Austin, Tex.

Discussion

R. M. DIXON, Chairman, Texas State Board of Water Engrs., Austin, Tex.

4:10 Dallas Quest for Water

JAMES A. COTTON, M. ASCE, Partner, Forrest & Cotton, Consulting Engrs., Dallas, Tex.

Pipeline Committee of Construction Division

2:30 p.m. **Texas Room**

Presiding: Elden V. Hunt, Chairman, Executive Committee, Committee on Pipelines, Construction Division

2:30 Civil Engineering in Pipelining

STEPHEN D. BECHTEL, JR., A.M. ASCE, Vice-President, Bechtel Corporation, San Francisco, Calif.

Economics of Natural Gas for the State of Florida

Introduction of speakers by C. C. Barnard, A.M. ASCE, Barnard and Burk, Consulting Engineers, Baton Rouge, La., and Vice-President of Houston, Tex., Gas and Oil Corp.

3:00 Markets, Rates and Competition

S. J. HELFMAN, Chief Utility Engineer of Barnard and Burk, Baton Rouge, La.

3:30 The Design and Economics of the Pipeline

PAUL HERZIG, Vice-President, Houston, Tex., Gas and Oil Corp.

4:15 Discussion period

4:45 Natural Gas on the Move

Sound-color motion picture presented by American Gas Association.

Conditions of Practice

2:30 p.m. **English Room**

Presiding: Frank L. Weaver, Chairman, Department of Conditions of Practice, and Glenn W. Holcomb, Vice-Chairman, Department of Conditions of Practice

2:30 Panel Discussion: Should Local Sections and Branches of ASCE Participate as a Unit in Political Activities?

BERNHARD DORNBLATT, M. ASCE, B. M. Dornblatt and Associates, Inc., New Orleans, La.

W. O. JONES, M. ASCE, Manager, Turnpike Engineers, Arlington, Tex.

3:30 Panel Discussion: Should Local Sections or Branches Sponsor Separate Junior Member Organizations?

WILLIAM J. CARROLL, J.M. ASCE, James M. Montgomery, Consulting Engr., Pasadena, Calif.

WALTER F. ALBRITTON, J. M. ASCE, Turnpike Engineers, Inc., Arlington, Tex.

Structural Division

2:30 p.m. **Lounge Room**

Presiding: Warren Raeder, Member, Executive Committee, Structural Division

2:30 Structural Imagination — the Theory and Construction of Thin Shells

MARIO G. SALVADORI, M. ASCE, Prof. of Civil Engineering, Columbia Univ., New York, N. Y.

3:45 Design of the Dallas Memorial Auditorium

BOYD G. ANDERSON, Assoc. Partner, Ammann & Whitney, Consulting Engineers, New York, N. Y.

4:30 Construction of the Dallas Memorial Auditorium

HENRY SHEPARD, Vice-President, Chief of Heavy Construction Div., R. P. Farnsworth & Co., Inc., New Orleans, La.

H. P. FARNSWORTH, JR., Director, General Supt. and Project Coordinator of Field Construction, R. P. Farnsworth & Co., Inc., New Orleans, La.

MISSOURI SCHOOL OF MINES ALUMNI DINNER

Wednesday Evening, Feb. 15

The alumni and friends of the Missouri School of Mines and Metallurgy will honor President Enoch R. Needles and Dean Curtis L. Wilson with a dinner.

SMU ENGINEERS' WEEK BANQUET

Ballroom, Umphrey Lee Student Center (Southern Methodist University Campus)

8:00 p.m., Wednesday, Feb. 15

Speaker: ELGIN B. ROBERTSON, Past President, American Institute of Electrical Engineers.

Presiding: CHARLES I. STANTON, JR., Chairman, Student Engineers' Joint Council, School of Engineering, Southern Methodist University.

All members of ASCE and students are cordially invited to attend. Per plate, $2.50.

ENTERTAINMENT AVAILABLE

Wednesday Evening, Feb. 15

Cinerama Holiday **8:30 p.m.**

Reserved tickets are available at the box office, Melba Theater, for the evening theater performance of "Cinerama Holiday." Tickets, $2.40 each, must be purchased by noon on Wednesday for the reserved section. The evening performance starts at 8:30 p.m.

Margo Jones Theater '55–'56

Evening, 8:30 p.m.
Matinee, 2:30 p.m.

Nationally known Margo Jones Theater '55–'56 will be presenting "Tolka Row," with Maura Laverty. Requests for tickets should be mailed to Box Office, Margo Jones Theater '55–'56, 1411 Commerce Street, Dallas, Tex., accompanied by your check.

Tickets for the evening performance are $3.00, and for the matinee $2.15. A limited number of tickets may be available at the time of registration. The theater is located in the State Fair Park.

THURSDAY MORNING

FEB. 16

Highway and Structural Divisions, Joint Session

9:30 a.m. **Lounge Room**

Presiding: Randle B. Alexander, Member of Committee on Sessions Programs, Highway Division

Phil M. Ferguson, Member of Com-

mittee on Sessions Programs, Structural Division

9:30 Design of the High-Level Bridge Across the Corpus Christi Ship Channel

PAT W. CLARK, Bridge Engr., Lockwood & Andrews, Consulting Engineers, Houston, Tex.

10:15 Reconstruction of the International Bridge at Laredo, Tex.

BENGT SONESSON, Resident Engr., City of Laredo

FRED E. KOEBEL, J.M. ASCE, Vice-President and Chief Engr. of Prestressing, Inc., San Antonio, Tex.

11:00 Dynamic Stress and Vibration in Two Continuous Plate Girder Bridges

ROY C. EDGERTON, A.M. ASCE, Research Engr., Oregon State Highway Dept.

GORDON W. BEECROFT, J. M. ASCE, Asst. Research Engineer, Oregon State Highway Dept.

11:40 Progress Report of the Committee on Deflection Limitations of Bridges

GEORGE S. VINCENT, M. ASCE, Bridge Engr., Bureau of Public Roads, Physical Research Branch.

HIGHWAY DIVISION LUNCHEON

Terrace Room, 17th Floor — Baker Hotel

12:15 p.m. Thursday, Feb. 16

Sponsored by the Highway Division

Speaker: J. C. DINGWALL, M. ASCE, Manager and Executive Secretary, Texas Toll Road Authority

Subject: "Right-of-Way Acquisition for Dallas–Fort Worth Toll Road"

Presiding: D. C. GREER, M. ASCE, Highway Engineer, Texas State Highway Department.

All members, guests, and friends of ASCE are cordially invited. Per plate, $2.25.

Pipeline Committee of the Construction Division

9:30 a.m. — Texas Room

Presiding: W. W. Studdert, Chairman, Program Committee, Committee on Pipelines

9:30 Late Developments in Offshore Pipeline Construction—Illustrated with color slides

DONALD M. TAYLOR, Editor, **Pipe Line Industry,** Gulf Publishing Co., Houston, Tex.

10:00 Soil Survey and Triangulation Problems on Offshore Pipeline Survey and Construction

CLYDE ALDRIDGE, A.M. ASCE, Engr., Magnolia Pipe Line Co., Dallas, Tex.

10:30 Submarine Pipeline Construction—Motion picture and discussion

S. V. COLLINS, Collins Construction Co., Fort Lavaca, Tex.

11:30 Discussion period

PIPELINE COMMITTEE LUNCHEON

Crystal Ballroom, Mezzanine — Baker Hotel

12:15 p.m. Thursday, Feb. 16

Sponsored by the Construction Division's Pipeline Committee

Presiding: ELDON V. HUNT, M. ASCE, Chairman, Executive Committee, Committee on Pipelines; Chief Engineer, the Alberta Gas Trunkline Co., Ltd., Calgary, Alberta, Canada.

All members, guests, and friends of ASCE are cordially invited. Per plate, $2.25.

Sanitary Engineering Division

9:30 a.m. — Crystal Ballroom

Presiding: Gordon W. Parkhill, Secretary, Sanitary Engineering Technical Group, Texas Section

Opportunities in Sanitary Engineering

9:30 Engineering Job Opportunities in World Health

HERSHEL ENGLER, Sanitary Engineering Director, Asst. Chief, Health Services Branch, Div. of International Health, Dept. of Health, Education and Welfare, Public Health Service, Washington, D. C.

10:20 Engineering Responsibilities in Malaria Eradication Programs

PATRICK N. OWENS, Sanitary Engr., Pan American Sanitary Bureau, Mexico City, Mex.

11:10 Revenue Bonds or Tax for Financing Water and Sewer Improvements

FRANK W. BEARD, A.M. ASCE, Consulting Engineer, Houston, Tex.

Waterways Division

9:30 a.m. — Banquet Room 5

Presiding: Rufus W. Putnam, Member, Executive Committee, Waterways Division

9:30 New Locks on the Lower Mississippi and Gulf Intracoastal Region

NORMAN R. MOORE, M. ASCE, Chief, Engineering Division, Lower Mississippi Valley Div., Corps of Engineers, Vicksburg, Miss.

10:05 Developing Port Facilities on Houston's Ship Channel

FRANK H. NEWNAM, JR., M. ASCE, Partner, Lockwood & Andrews, Consulting Engineers, Houston, Tex.

10:40 Economics of Improving the Gulf Intracoastal Waterway in Texas

W. P. MCCRONE, M. ASCE, District Engr., Galveston District, Col., U. S. Corps of Engineers, Galveston, Tex.

11:15 Port Development at Corpus Christi

DUANE ORR, A.M. ASCE, District Engr., Nueces County Navigation District, Port of Corpus Christi, Corpus Christi, Tex.

FACULTY ADVISERS' CONFERENCE

Green Room, 17th Floor — Baker Hotel

9:30 a.m. Thursday, Feb. 16

Faculty Advisers from ASCE Student Chapters in the Southwestern area will convene for a one-day discussion of Student Chapter problems. This conference, which is primarily for invited Advisers, will be open to all Contact and Junior Contact Members of Chapters, and others interested in the activities and operational details of ASCE Student Chapters.

THURSDAY AFTERNOON

FEB. 16

Construction and Structural Division, Joint Sessions

2:00 p.m. — Crystal Ballroom

Presiding: Maurice N. Quade, Member, Executive Committee, Structural Division

2:00 DeLong Dock

G. E. SUDEROW, Vice-President and Chief Engr., DeLong Corp., New York, N. Y.

2:45 Pneumatic Caisson Pier Carries World's Longest Pipeline Suspension Bridge

JOHN N. NEWELL, M. ASCE, Chief Engr., Massman Construction Co., Kansas City, Mo.

3:20 The Painting of Steel Structures

E. J. RUBLE, M. ASCE, Research Engr. of Structures, Association of American Railroads, Chicago, Ill.

Highway Division

2:00 p.m. **Lounge Room**

Presiding: Emmett H. Karrer, Chairman, Executive Committee, Highway Division

2:00 The Purpose of Expressways

FRANK S. CRAIG, J.M. ASCE, Expressway Engr., Texas Highway Dept., Wichita Falls, Tex.

2:30 Foreign Operations of the Bureau of Public Roads

A. C. TAYLOR, M. ASCE, Div. Engr., Bureau of Public Roads

3:10 Functions and Aims of the Texas Transportation Inst.

FRED BENSON, A.M. ASCE, Executive Officer, Texas Transportation Inst., College Station, Tex.

3:40 Concrete Pavement, Concrete Overlay

A. L. CHOLLAR, A.M. ASCE, Supervising Field Engr., Texas Highway Dept.

Pipeline Committee of Construction Division

2:00 p.m. **Texas Room**

Presiding: J. B. Spangler, A.M. ASCE, Secretary, Executive Committee, Committee on Pipelines

2:00 Application of a Magnetic Drum Electronic Computer to Pipeline Design

Illustrated with slides.

HAROLD E. THOMAS, Pipeline Design Section, El Paso Natural Gas Company, El Paso, Tex.

2:30 Photogrammetry in Pipeline Engineering

MARSHALL S. WRIGHT, JR., Engineering Consultant, Jack Ammann Photogrammetric Engineers, Inc., San Antonio, Tex.

3:00 Underground Storage of Gas in Relation to Pipeline Operations

JOHN VIGLINI, Asst. Chief. Engr., Transmission Div., Lone Star Gas Co., Dallas, Tex.

3:30 Maintaining Line Efficiency in Natural Gas Pipelines by Liquid Removal

A. W. RIFENBURGH, Mississippi River Fuel Corp., St. Louis, Mo.

4:00 Panel Discussion of Items of Common Interest

Waterways and Hydraulics Divisions, Joint Session

2:00 p.m. **Banquet Room 5**

Presiding: Rufus W. Putnam, Member, Executive Committee, Waterways Division; and Harold M. Martin, Secretary, Executive Committee, Hydraulics Division

2:00 Trinity River Flood Control Project

JAMES A. COTTON, M. ASCE, Partner, Forrest and Cotton, Consulting Engineers, Dallas, Tex.

WILLIAM E. WOOD, A.M. ASCE, Fort Worth District, Corps of Engineers, Fort Worth, Tex.

2:40 Houston Floodway

KENNETH HEAGY, M. ASCE, Chief, Engineering Div., Galveston District, Corps of Engineers, Galveston, Tex.

3:20 Rio Grande River Problems

J. F. FRIEDKIN, M. ASCE, Principal Engr., International Boundary and Water Commission, U. S. Section, El Paso, Tex.

J. C. BUSTAMENTE, M. ASCE, Principal Engr., International Boundary and Water Commission, Mexican Section, El Paso, Tex.

4:00 Wichita and Valley Center Project, Wichita, Kansas

MYRON W. DEGEER, A.M. ASCE, Asst. Chief, Engineering Div., Tulsa Dist., Corps of Engineers, Tulsa, Okla.

DINNER DANCE

Terrace Room, 17th Floor **Baker Hotel**

Thursday Evening, Feb. 16

7:30 p.m. Dinner, 9:00 p.m. Dance

Dress informal.

For this evening social, there will be delightful music during the dinner by a string ensemble. There will be no head table or reserved tables, and friends are urged to arrange their own groups. After the dinner, dancing will be to the music of an outstanding orchestra of the Southwest.

Set-ups will be available from the waiters at a nominal cost. Students will be admitted to the dance portion of the evening without cost.

Per plate, $8.75.

FRIDAY MORNING

FEB. 17

Engineering Mechanics Division

9:30 a.m. **Banquet Room 5**

Presiding: Albert G. H. Dietz, Chairman, Plastics Committee, Engineering Mechanics Div.

9:30 Classes of Plastics Materials

GORDON M. KLINE, Chief, Organic Materials Div., National Bureau of Standards, Washington, D. C.

10:10 Plastics—Engineering Materials

C. HOWARD ADAMS, Monsanto Chemical Company, Plastics Div., Springfield, Mass.

10:50 Plastics in Buildings

ALBERT G. H. DIETZ, M. ASCE, Prof. of Building Engineering and Construction, Mass. Inst. of Technology, Cambridge, Mass.

11:30 Plastics in Water Supply

WALTER TIEDEMAN, Director of the Laboratory, National Sanitation Foundation, Ann Arbor, Mich.

Irrigation and Drainage Division

9:30 a.m. **Lounge Room**

Presiding: John H. Bliss, Member, Executive Committee, Irrigation and Drainage Division

9:30 Ground Water Conservation in the Texas High Plains

W. L. BROADHURST, Chief Hydrologist, High Plains Underground Water Conservation District No. 1, Lubbock, Tex.

10:15 The Peoria Recharge Pit

MAX SUTER, M. ASCE, Head, Engineering Research Subdiv., State Water Survey Div., Peoria, Ill.

11:00 The Importance of Salt Balance to Ground Water Reservoir Operation

DAVID B. WILLETS, A.M. ASCE, Supervising Hydraulic Engr., Div. of Water Resources, State of California, Sacramento, Calif.

CHARLES A. MCCULLOUGH, J.M. ASCE, Senior Hydraulic Engr., Div. of Water Resources, State of California, Sacramento, Calif.

Structural Division

9:30 a.m. **Crystal Ballroom**

Presiding: Ernest C. Hartmann, Chairman, Executive Committee, Structural Division

9:30 Repetition of Details on 30-Story Welded Office Building

DON W. KIRK, Chief Engr., Preston M. Geren, Architect & Engr., Fort Worth, Tex.

10:15 Engineering Design Features of the Kelly Air Force Base Maintenance Hangar

N. H. ASLANIAN, A.M. ASCE, Design Engr., The Kuljian Corp., Philadelphia, Pa.

11:00 Lateral Load Distribution Test on Launched Continuous Steel Beam Bridge

WILLIAM B. PURNELL, Assoc. Prof., Dept. of Civil Engineering, Univ. of Houston, Houston, Tex.

ARDIS WHITE, A.M. ASCE, Asst. Prof., Dept. of Civil Engineering, Univ. of Houston, Houston, Tex.

Soil Mechanics and Foundations Division

9:30 a.m. **Texas Room**

Presiding: Bramlette McClelland, Chairman, Soil Mechanics Group, Texas Section

9:30 Consolidation Study in Swelling Clay

FRANK G. BRYANT, J.M. ASCE, Asst. Prof., Univ. of Texas, Austin, Tex.

10:15 Use of Preload Fills Without Sand Drains

J. BRES EUSTIS, M. ASCE, Eustis Engineering Co., Consulting Foundation Engineers, New Orleans, La.

11:00 Sand Drains at Surfside Bridge Checked by Subsequent Borings

FRANK S. MITCHELL, JR., A.M. ASCE, Senior Lab. Engr., Texas Highway Dept., Houston, Tex.

SOIL MECHANICS AND FOUNDATIONS DIVISION LUNCHEON

Texas Room **Baker Hotel**

12:15 p.m., Friday, Feb. 17

Sponsored by the Soil Mechanics and Foundations Division

Speaker: RAYMOND C. MASON, A.M. ASCE, Mason-Johnston & Associates, Consulting Engineers, Dallas, Tex.

Subject: "Problems of Earth-Dam Design in Rain Forests," lecture illustrated with colored slides.

Presiding: RAYMOND F. DAWSON, M. ASCE, Director, District 15, Austin, Tex.

All members, guests, and friends of ASCE are cordially invited. Per plate, $2.25.

STUDENT LUNCHEON

Terrace Room, 17th Floor **Baker Hotel**

12:15 p.m., Friday, Feb. 17

Presiding: CLIFFORD D. WILLIAMS, Chairman, Committee on Student Chapters, ASCE

An informal program has been planned for the luncheon period. All members, guests and friends of ASCE are cordially invited. Students will secure their tickets at the time of registration. Per plate, $2.25. No charge for students.

FRIDAY AFTERNOON

FEB. 17

Irrigation and Drainage Division

2:00 p.m. **Lounge Room**

Presiding: John H. Bliss, Member, Executive Committee, Irrigation and Drainage Division

2:00 Design of Major Drainage Canals

EDWIN W. EDEN, JR., M. ASCE, Chief, Hydrology and Hydraulics Section, Jacksonville District, U. S. Corps of Engineers, Jacksonville, Fla.

2:40 The Importance of Soil Moisture in Agriculture

E. G. WILLIAMS, Manager, Irrigation Research and Development, Little Rock Div. Office, Olin Mathieson Chemical Corp., Little Rock, Ark.

3:20 Soil, Moisture, and Plant Relationships and Their Influence on Irrigation

JAMES V. MADISON, Supervisory Soil Scientist, Kansas River Projects, U. S. Bureau of Reclamation, McCook, Nebr.

J. WILLIS ERVIN, Irrigation Agriculturist, Kansas River Projects, U. S. Bureau of Reclamation, McCook, Nebr.

STUDENT CHAPTER PAPER CONTEST AND CONFERENCE

Terrace Room, 17th Floor **Baker Hotel**

2:00 p.m., Friday, Feb. 17

Presiding: J. G. Rollins, Chairman, Texas Section Committee on Student Chapters

2:00 Student Paper Contest sponsored by the Texas Section, ASCE

4:30 Texas Student Conference Meeting

5:00 Presentation of Awards by President Enoch R. Needles.

Soil Mechanics and Foundations Division

2:00 p.m. **Texas Room**

Presiding: Willard J. Turnbull, Member, Executive Committee, Soil Mechanics and Foundations Division

2:00 Field Load Tests on Straight Shaft and Under-Reamed Piles

LAWRENCE A. DUBOSE, A.M. ASCE, Asst. Prof. of Civil Engineering, A. & M. College of Texas, College Station, Tex.

2:45 Pile Loading Tests, Old River Low-Sill Structure

C. I. MANSUR, M. ASCE, Asst. Chief, Embankment and Foundation Branch, Waterways Experiment Station, Vicksburg, Miss.

R. I. KAUFMAN, Chief Design and Analytical Section, Waterways Experiment Station, Vicksburg, Miss.

3:15 Load Test on 333-Ft Friction Pile in Deep Under-Consolidated Clay

LINDSEY LIPSCOMB, J.M. ASCE, Senior Civil Engr., Humble Oil and Refining Company, Houston, Tex.

BRAMLETTE MCCLELLAND, A.M. ASCE, McClelland Engineers, Houston, Tex.

4:00 Foundation Studies for DeLong Pier in the Norfolk, Virginia, Area

W. G. SHOCKLEY, A.M. ASCE, Chief, Embankment and Foundation Branch, Waterways Experiment Station, Vicksburg, Miss.

T. B. GOODE, Chief, Inspection and Exploration Section, Waterways Experiment Station, Vicksburg, Miss.

PLANNED TOURS

Pipeline Committee Tour

Friday, Feb. 17, 9:00 a.m.

Special buses will leave the Akard Street entrance of the Baker Hotel at 9:00 a.m. to visit interesting pipeline installations and facilities in the Dallas vicinity.

Other Tours

Dallas–Fort Worth Toll Road

Dallas Memorial Auditorium

Turtle Creek Pressure Sewer Project, Corps of Engineers

Inspection of the above construction projects will be arranged by the Convention Committee for persons interested. Arrangements will be informal, and can be made at the time of registration.

LADIES HOSPITALITY ROOM

Camelia Room, Mezzanine, Baker Hotel, Daily

The Hospitality Room will be the gathering place of all ladies attending the Convention. Coffee will be served on Wednesday, Thursday, and Friday mornings between 9:30 a.m. and 11:30 a.m. Hostesses will be the Dallas ASCE Wives Club members.

LADIES PROGRAM

Tuesday, Feb. 14

Brunch. A Brunch will be held at the nationally famous Neiman Marcus Zodiac Room, located at Commerce and Ervay Streets. A style show plus favors will be part of the entertainment. Per plate, $2.75.

Western Ranch Party. The ladies will join the men in a gala affair at 6:30 p.m., at Louann's, located at Greenville Avenue and Lovers' Lane. Western clothes will be the motif. Cocktails will be followed by a ranch-style meal. Buses will start leaving the Akard Street entrance of the Baker Hotel at 6:00 p.m. Per plate, $3.50.

Wednesday, Feb. 15

Governor's Luncheon. Honorable Allan Shivers, Governor of the State of Texas, will address all of the ASCE members and ladies attending the Convention, at the 12:30 p.m. luncheon. Per plate, $2.50.

Tour and Tea at the Republic National Bank. Starting at 3:00 p.m., tour will be conducted through the newest major bank in the Southwest, ending in a tea with the compliments of the Republic National Bank of Dallas. The bank is located at the corner of Ervay and Pacific, within easy walking distance of the Headquarters Hotel. No charge.

Thursday, Feb. 16

Ladies Luncheon. Lunch will be served at 12:00 noon in the Junior Ballroom of Dallas' new Statler-Hilton Hotel. No formal program has been planned and everyone should have an enjoyable time at the newest and most modern hotel in the Southwest. Per plate, $2.50.

HOTEL ACCOMMODATIONS

Headquarters for the Dallas Convention will be the Baker Hotel, 1400 Commerce Street. Special arrangements have been made with this hotel to house many of those attending the Convention, in the order that reservation requests are received. Accommodations in other hotels and motels may be made.

Send your requests as early as possible to assure the accommodations you prefer. For your convenience, a special request form is provided on page 104 of this issue.

BOARD MEETINGS

Board of Direction, ASCE, Monday and Tuesday, Feb. 13 and 14, Room 5.

Texas Section, Board of Directors, Tuesday, Feb. 14, Banquet Room No. 4.

CONVENTION OFFICE AND PRESS ROOM

Rooms 1 and 2, Mezzanine Baker Hotel

For the convenience of the members and the operation of the Convention, Rooms 1 and 2 will be used throughout the Convention as a business office and press room.

INFORMATION AND REGISTRATION

Information and registration facilities will be maintained on the mezzanine floor of the Headquarters Hotel throughout the days of the Convention. Mail and messages will be held for members at the information desk.

DALLAS CONVENTION GENERAL COMMITTEE

I. W. Santry, Jr., *General Chairman*
J. W. Porter, *President, Texas Section*

Executive Committee
I. W. Santry, Jr., *Chairman*
Dick B. Granger, *Vice-Chairman*
J. G. Rollins, *President, Dallas Branch*

Reception
T. C. Forrest, Jr., *Chairman*

Ladies Program
Mrs. Karl Hoefle, *Chairman*

Publicity
T. E. Huffman, *Chairman*

Entertainment
Franklin Martine, *Chairman*

Registration
J. R. Padgitt, *Chairman*

Finance
J. W. Porter, *Chairman*

Hotel Arrangements
R. L. Powell, *Chairman*

Transportation
O. G. Rayner, *Chairman*

Student Activities
J. G. Rollins, *Chairman*

Technical Program
Sophus Thompson, *Chairman*

SOCIETY NEWS

PEACE ON EARTH ★ GOOD WILL TOWARD MEN

Dallas Set for Big Time at ASCE Convention

Dallas, Tex., setting for the Society's 1956 Winter Convention, is one of the youngest and most cosmopolitan of America's big cities. Within a period of slightly more than 100 years, Dallas has grown from a log-cabin frontier outpost to a city famed for its good citizenship, its beautiful skyline, its cultural facilities, and its diversified economy of agriculture, oil, manufacturing, banking and insurance.

"Big D" is the Southwest's affectionate term for Dallas, a metropolis of approximately 750,000 population. A city of remarkable contrasts, Dallas likes to boast of its culture and urbanity while reserving the right to enjoy itself in traditional unfettered Western style. There are dude ranches, as well as the genuine article, nearby the city. In the shops of downtown Dallas one can buy everything—from a pair of custom-made cowboy boots or a seven-star Stetson to the most exclusive fashion imports. In fact, high fashion is big business in Dallas. The ladies come from far and wide to shop there, and it is commonplace for prosperous residents of Mexico City to fly in with the family for a shopping weekend.

The climate makes the big difference in recreation in Dallas. With the temperature norm for the city much the same as that of Los Angeles, outdoor sports are just as popular on a balmy mid-February day as in August. Thus barring a relatively unusual but unpredictable Texas "norther," the ASCE Convention, February 13–17, is likely to be blessed with comfortable, even spring-like weather.

For years, the Southwest has come to Dallas for entertainment. The city boasts the only Cinerama Theater in the Southwest. For lovers of the stage there is the unique Margo Jones theater where professional productions are presented "in the round." This was the first successful arena theater in the country and has sent a number of productions on to New York, including the current Broadway hit, "Inherit the Wind." During the period of the ASCE Convention the Margo Jones Theater will be presenting "Tolka Row," the first production in the United States of a play by the distinguished Irish playwright, Maura Laverty of the Dublin Theater.

Another cultural attraction for ASCE Convention visitors is a concert by the nationally famous Dallas Symphony Orchestra, under the baton of Conductor Walter Hendl, scheduled for Monday night, February 13. The concerts are presented in McFarlin Auditorium, on the campus of Southern Methodist University. On Sunday, February 19, the Symphony will present a special concert directed by the celebrated British conductor, Thomas Beecham.

Dallas has one of the nation's outstanding civic centers at State Fair Park. The fair grounds are open to visitors all year round, and admission is free to four museums and the Aquarium located in Fair Park. The museums are the Museum of Fine Arts, Dallas Health Museum, Museum of Natural History and the Texas Hall of State, which contains a comprehensive Museum of Texas History.

Dramatic skyline of Dallas—city of improbable contrasts between the old and the new, the urban and the frontier—rises above the plain. Dallas will be host to the ASCE Convention, February 13–17. The Baker Hotel will be Convention headquarters.

The social events in store for Convention visitors (details in the Convention Program printed elsewhere in this issue) promise a pleasant change of pace from traditional Convention programs. Particularly exciting is the Western Ranch Party, scheduled for Tuesday evening, February 14, and featuring a ranch-style meal and fiesta, courtesy of the Texas Section. There will be dinners and dances and luncheons galore, but Wednesday evening will be left more or less open to give theater lovers a chance to attend the Margo Jones Theater.

The technical program, with its 22 sessions, will appeal to a wide range of engineering interests. In addition, the spotlight will be on professional subjects in several programs sponsored by the Department of Conditions of Practice. Sophus Thompson is chairman of the technical program, and I. W. Santry, Jr., is general Convention chairman.

Sporting Texan garb, Texas contingent invites Annual Convention visitors to attend Dallas Convention. Shown here with ASCE Past-President J. C. Stevens (third from left), they are (in usual order) John A. Focht, John Simms, Mr. Stevens, John A. Focht, Jr., Section President J. W. Porter, and Convention Chairman I. W. Santry.

As the Southwest's most important transportation center, Dallas is served by nine federal highways and nine major railway lines. One of the nation's most modern airport terminals, complete with moving sidewalks and air-conditioned ramps, is under construction at Dallas' Love Field, which is served by three trunkline air carriers and ranks as the sixth busiest airport in the nation.

Puerto Rico Section Host to Post-Convention Tour

A special meeting of the Puerto Rico Section was expanded to extend over several days and to include inspection of insular construction works by a group of engineers from the States. The occasion was the coincidence of a Section meeting to award Certificates of Life Membership with the President's Post-Convention Inspection Tour, which followed immediately the Society's Annual Convention in New York. Dates of the joint venture were October 29 through November 2.

The Puerto Rico Section meeting, on October 31, featured the award of Life Membership Certificates to Robert J. Auld and L. C. Waterbury by ASCE President Enoch R. Needles. Colonel Needles was leader of the group of officers and members who, with their wives, were also inspecting the engineered facilities of the Commonwealth. In an address to the Section, President Needles lauded the rapid economic growth of Puerto Rico, emphasizing the part played in such expansion by engineers. The President and others in his party had been impressed by the extent and variety of new works constructed and in progress, as revealed during a series of inspection tours by air and highway.

The first of the tours arranged by the Section was sponsored by the Water Resources Authority of Puerto Rico. A new plane used by the Authority for its surveys and inspections carried the visiting engineers over many of the facilities, later to be seen in detail from the ground. Conducted by ASCE members Miguel A. Quinones and Pedro Colon-Pagan, of the Water Resources Authority, the air tour brought sharply into focus the extensive works completed as well as the challenge to the profession posed by the terrain.

Preparation for the ground phases of the tour included a briefing at the spacious headquarters of the Colegio Ingenieros de Puerto Rico and a luncheon given by the Colegio at the spectacular new Isla Verde Airport. Puerto Rico Section President José Manuel Canals led the cavalcade of automobiles to numerous points of engineering interest. In addition to Mr. Canals, the committee on arrangements consisted of Jorge J. Jiminez, William C. Hill, Kenneth W. Ahbol, Stanley G. Kadala, Jr., Robert J. Auld and Miguel A. Quinones.

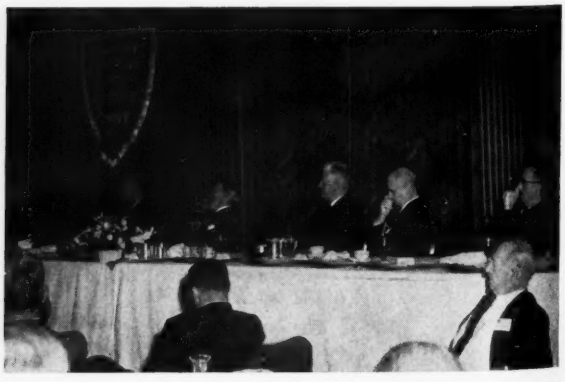
Seen at head table during Puerto Rico Section's annual dinner to award Life Membership Certificates are (left to right): L. C. Waterbury, new Life Member; Mrs. José Canals; Section President Canals; ASCE President Enoch R. Needles; Robert J. Auld, new Life Member; and Mrs. Needles.

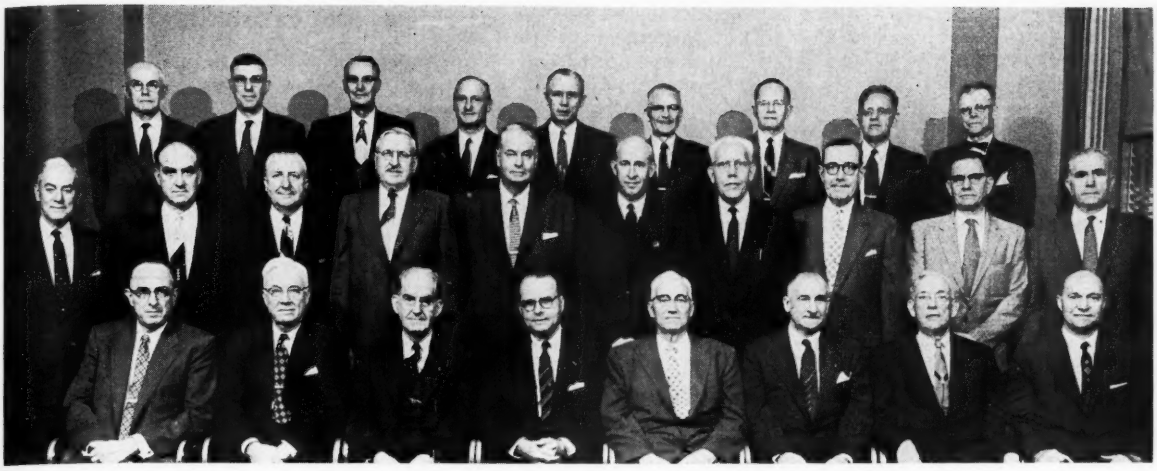
Seen at the Annual Convention

ASCE members and their ladies don hard hats for tour of the Brooklyn Navy Yard, major inspection trip of this year's Annual Convention. Photo gives an idea of the giant size of the supercarrier, "U.S.S. Saratoga," which towers in the background. Inset shows Rear-Admiral R. T. Cowdrey, commander of the Brooklyn Navy Yard and principal speaker at the ASCE luncheon there. In view at right retiring Vice-President Mason Lockwood addresses Soil Mechanics Luncheon. To his right is Vice-President Louis R. Howson and at his left President Needles. Partly hidden by the lectern is Presiding Officer Stanley D. Wilson.

Convention visitors from afar greet Past-President R. E. Dougherty and President Enoch R. Needles (second and third from left in left-hand photo). At left is Prof. Tae-Sang Won, dean of Seoul National University, Seoul, Korea, and director of Korean Society of Engineers, and at right Solomon S. Morris, city engineer of Capetown, South Africa, and author of a Convention paper.

Photographed at head table at Professional Cooperation Luncheon (left to right in bottom views) are E. L. Chandler, Assistant Secretary of ASCE; W. N. Landers, secretary, Society of Naval Architects and Marine Engineers; E. L. Slagle, president, American Institute of Industrial Engineers; H. F. Roemmele, president, New York State Society of Professional Engineers; M. D. Hooven, president, AIEE; ASCE Vice-President F. L. Weaver; E. R. Needles, ASCE President-elect; W. R. Glidden, ASCE President; Mason G. Lockwood, Vice-President of ASCE and toastmaster; ASCE Executive Secretary W. H. Wisely; Thorndike Saville, president, EJC; H. DeWitt Smith, president, AIME; W. L. Collins, secretary, ASEE; and R. C. Cross, secretary, American Society of Refrigerating Engineers.





New ASCE Board of Direction Takes Office at New York Meeting

Incoming Board of Direction is photographed during one of its Annual Convention sessions in New York last month. In front row (left to right) are Glenn W. Holcomb, Vice-President Zone IV; Louis R. Howson, Vice-President, Zone III; ASCE Past-President William R. Glidden; President Enoch R. Needles; Past-President Daniel V. Terrell; Frank L. Weaver, Vice-President, Zone II; Frank A. Marston, Vice-President, Zone I; and William H. Wisely, Executive Secretary. Second row shows Carey H. Brown, Director, District 3; Lawrence A. Elsener, Director, District 11; Don M. Corbett, Director, District 9; Oliver W. Hartwell, Director, District 4; Samuel B. Morris, Director, District 11; John P. Riley, Director, District 1; George S. Richardson, Director, District 6; Jewell M. Garrelts, Director, District 1; Louis E. Rydell, Director, District 12; and Frederick H. Paulson, Director, District 2. In the third row are Robert H. Sherlock, Director, District 7; William S. LaLonde, Jr., Director, District 1; Ernest W. Carlton, Director, District 14; Mason C. Prichard, Director, District 5; Graham P. Willoughby, Director, District 10; R. Robinson Rowe, Director, District 11; Clarence L. Eckel, Director, District 16; Raymond F. Dawson, Director, District 15; and Thomas C. Shedd, Director, District 10.

Revision of Article 4 of Code of Ethics Proposed

At its meeting during the Annual Convention, the Board of Direction of ASCE adopted the recommendation of the Committee on Professional Practice to amend Article 4 of the Code of Ethics (November issue, page 69). The Article, which concerns "bidding on a price basis," now reads "It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers to participate in competitive bidding on a price basis to secure professional engagement."

By established procedure, ratification of the Board's action is required by a referendum of the membership. So that the membership may fully understand the proposed amendment the statement of the Committee on Professional Practice is here presented.

Reasons for Amendment of Article 4

There has been for many years a prohibition in the Code of Ethics of the Society against competitive bidding on a price basis to secure a professional engagement. There has not been, however, any clear definition of "bidding on a price basis" with the result that there have been widely divergent interpretations, which has made enforcement impracticable except in flagrant cases. Some engineers consider that the prohibition applies only to submission of sealed bids in response to a public advertisement. At the other extreme, many engineers decline to submit a price if they have reason to believe that a price is being requested from others.

The Board of Direction, therefore, requested the Committee on Professional Practice to develop and recommend a definition of "competitive bidding on a price basis to secure an engineering engagement" that would clearly delineate the line between proper professional competition among engineers and competition which is not professionally ethical and proper. The Committee, after soliciting and receiving the advice of a large number of engineers and after soliciting and receiving advice from the members of the Board of Direction, has recommended that Article 4 of the Code of Ethics be amended to read as follows:

> "It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers to invite proposals for the performance of professional engineering services or to state a price for such services in response to any such invitation when there are reasonable grounds for belief that price will be the prime consideration in the selection of the engineer."

In order to follow the negative form of

the Code of Ethics, this provision states what is improper. Positively stated, it will be considered professional and consistent with honorable and dignified bearing for any member of the American Society of Civil Engineers to invite proposals for the performance of professional engineering services or to state a price for such services in response to any such invitation when professional qualifications will be given prime consideration.

It follows that both solicitation and submission of sealed bids in response to a public advertisement would be a clear violation of the Code of Ethics. It also follows that this prohibition can be avoided neither by recourse to informalities such as requests by letter to submit proposals nor by statements in a proposal to the effect that it is assumed that the professional qualifications of the engineer will be given prime consideration.

The recommended amendment to Article 4 of the Code of Ethics leaves in the realm of that which is proper all the procedures necessary for adequate protection of the interests of the client and the public. Negotiation of a price after provisional selection of an engineer based on professional qualifications (the procedure described in ASCE Memorandum, M5) is retained as best in the public interest. Any public official, a member of the Society, is left free to request proposals for performance of professional engineering services, provided only that he shall have reasonable grounds for belief that professional qualifications, including experience on similar work, and current work load, rather than price, will be given prime consideration in the selection of the engineer.

No definition can be written which will clearly delineate the line between professional competition among engineers and competition which is not professionally ethical and proper. However, the recommended revision of Article 4 of the Code of Ethics does afford a basis for each individual member to judge his own conduct. The Society can provide advice and guidance and enforce compliance where necessary, but it will always be the responsibility of the individual engineer to act in a manner that brings credit to the profession.

In brief, Article 4 of the Code of Ethics has been honored in the breach because of lack of agreement as to its intent. The proposed revision of Article 4 is believed to conform to the interpretation desired by most of the members of the Society. It is recognized that there will be many border-line cases, but any engineer capable of performing the required professional services should be capable of judging whether qualifications or price will be the determining factor in the selection of the engineer. In any event, the Committee on Professional Conduct will be in a position to judge whether or not there were reasonable grounds for believing that price was the prime consideration.

[Raymond A. Hill heads the Committee on Professional Practice, which consists also of N. T. Veatch, vice-chairman; Lloyd D. Knapp, contact member; Herbert C. Gee, Karl R. Kennison, Shortridge Hardesty, A M Rawn, and R. M. Whitton.]

Board Studies Participation of ASCE in Public Affairs

Among the topics to be discussed by the ASCE Board of Direction at the Dallas Convention is the Society's policy regarding public pronouncements on local and national affairs. There have been instances in which a Local Section has made recommendations concerning public affairs of national or regional scope, when other Local Sections or the Board of Direction had taken a different stand. To resolve such situations, the Board requested the Executive Secretary to draft a statement of policy, which is presented below for review and comment by the membership-at-large.

Local Sections are encouraged to participate constructively in public affairs of interest and concern to civil engineers. It is important, however, that such activities be limited to the geographical area of the Section unless there is a cooperative effort on the part of two or more Local Sections.

Public affairs from the municipal to the state level will generally be left to the Local Section or Sections interested. A regional or District council of Local Sections may function in interstate problems within its area of jurisdiction.

All national affairs in the range of Society interest, including legislation, will be considered at the national level by the Board of Direction. Local Sections or regional or District councils may propose action for consideration by the Board, and submit it through appropriate channels within the Society. It should be noted here that Section 2 of Article IX of the Constitution provides that "Local Sections shall not speak for the Society as a whole unless so authorized by the Board of Direction."

The Executive Secretary is available for consultation and guidance when there is doubt as to the proper handling of a specific situation. Advice and clearance from headquarters also are to be obtained when reference to Society policy is made in any representation to a public agency.

California Engineers Hear Senator Malone

George Malone, A.M. ASCE, U. S. Senator from Nevada, addresses Engineering Council of Sacramento Valley. He is shown with R. Robinson Rowe, new Director of ASCE and chairman of the council. Senator Malone, who returned recently from a month's visit to Russia, said that there are only two world powers—the United States and Russia. In his opinion, the present approach to armed preparedness is wrong because it is based on the accumulation of obsolete equipment. George L. Sullivan, dean emeritus of the College of Engineering at Santa Clara University, was also a featured speaker.

ASCE MEMBERSHIP AS OF NOVEMBBR 9, 1955

Members	9,054
Associate Members	11,616
Junior Members	17,974
Affiliates	71
Honorary Members	41
Total	38,756
(November 9, 1954	37,789)

Journals and Two-Division Registration

As reported in CIVIL ENGINEERING for July (p. 74), the Proceedings of the Society will be issued as Journals of the various Technical Divisions beginning in January 1956. Because the technique of civil engineering is rapidly developing, this same month will also see the inauguration of a system whereby Society members can receive, automatically, the publications of two Technical Divisions of their choice. Only those who register in a Division or those who subscribe to the complete Proceedings of the Society will receive these Journals. The coupon for two-Division registration is on page 129.

Information concerning subscription to the complete Proceedings is on page 128.

This new publication procedure means that, as an added service, members will receive—not the separate papers with which they have become familiar—but a paper-bound technical periodical sponsored by the Divisions of their choice. As in the past, however, 100 free individual papers can be obtained by use of the coupon in CIVIL ENGINEERING. Thus the new system of publication offers the advantages of a more formal publication procedure plus the convenience of individual papers.

ECPD Authorizes Survey of Engineering Profession at Annual Meeting in Toronto

A resolution authorizing a comprehensive survey of the entire engineering profession in the next year was one of the important decisions coming out of the 23rd annual meeting of the Engineers Council for Professional Development, held in Toronto, October 13 and 14.

Thorndike Saville, M. ASCE, dean of the New York University College of Engineering and newly elected president of ECPD, said that the survey will be comparable to those recently completed by the legal and architectural professions. "The continuing shortage of engineering manpower renders ECPD's role increasingly vital," he added. "Our educational offerings must encompass the demands of new technological fields and must broaden the students cultural and intellectual horizons. Guidance procedures also must be strengthened so that the rate of failures, especially in the freshman year, can be curtailed."

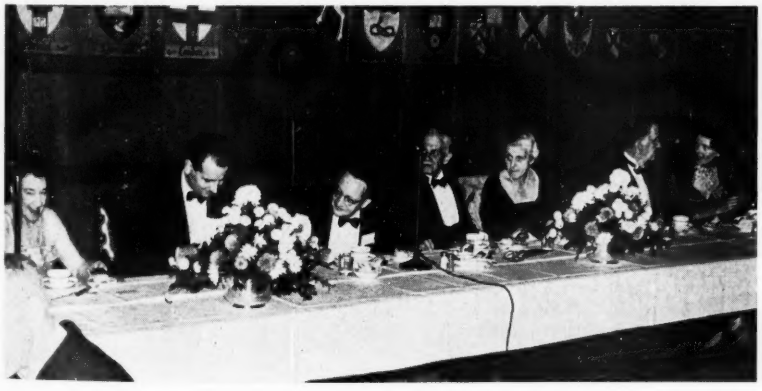
Another important step taken at the meeting, which attracted engineering educators from all over the United States and Canada, was the approval in principle of additional criteria for accreditation of engineering curricula. These criteria have as their objective "the assurance of an adequate foundation in science, humanities, engineering science, and introduction to engineering method while providing sufficient flexibility in science requirements to accommodate curricula requiring special backgrounds . . ." In substance, they require that all curricula contain at least the equivalent of one academic year of mathematics and basic science about equally divided, and that all curricula contain at least the equivalent of a year of engineering sciences.

Thorndike Saville

Exceptional interest was shown in the panel discussion on ethics, which featured talks by Prof. T. A. Boyle, of the University of Michigan; N. A. Christensen, M. ASCE, director of the Cornell University School of Civil Engineering; N. W. Dougherty, M. ASCE, dean of engineering at the University of Tennessee; Dean G. Edwards, M. ASCE, consulting engineer of Newark, N.J.; C. J. Freund, dean of engineering at the University of Detroit; G. Ross Lord, professor of mechanical engineering at the University of Toronto; J. E. L. Roy, chief engineer, Auxiliary Services, Quebec Hydroelectric Commission; and W. Stewart Wilson, assistant dean and secretary of the Faculty of Engineering and Science at the University of Toronto.

In a leading address S. C. Hollister, M. ASCE, dean of engineering at Cornell University, discussed education in relationship to utilization of engineers. Said Dean Hollister, "There is much evidence to show that only a certain proportion of our population has the necessary qualifications to undertake the engineering profession. Many of those qualifications are similar to those required for success in other lines." He warned that "we have reached a fixed percentage of the population that will enter engineering," despite the fact that service needs for the profession are increasing at an ever-accelerating rate. Dean Hollister observed that such threats to the profession "should motivate us to give heed to the need for a reevaluation of our professional activities." He pointed to the increased tempo of civilization in the past quarter of a century and noted that "the engineer is at the core of this development."

New ECPD officers for the coming year, in addition to Dean Saville, are R. G. Warner, vice-president; W. H. Wisely, M. ASCE, secretary; E. O. Kirkendall, assistant secretary; and S. L. Tyler, executive secretary. Installation of the new officers took place at the conclusion of the annual banquet.



Head table at ECPD annual banquet in the Great Hall at Hart House, University of Toronto, shows (left to right) Mrs. L. F. Grant; Dr. C. T. Bissell, vice-president of the University of Toronto; Presiding Officer M. D. Hooven, president of the AIEE and vice-president of ECPD; L. F. Grant, retiring president of ECPD; Mrs. R. R. McLaughlin; ASCE Past-President William R. Glidden; and Mrs. Bissell. Seen in the background are some of the seals of all the universities in the British Commonwealth that decorate the magnificent hall.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

The **Akron Section's** Memorial Fund—established in honor of prominent member L. L. Schmucker, who died in 1953—has been turned over to the University of Akron. Members attending the October meeting had their thoughts directed to the glories of ancient Roman architecture, as they endure in certain South of France structures, in an illustrated lecture ably presented by R. D. Landon, dean of the University of Akron's College of Engineering.

The **Arizona Section's** "Newsletter" is featuring guest editorials. Fred Glendening, Maricopa County engineer, is guest author for October with a thoughtful outline of the county road situation. Phoenix Member C. H. Whalin is editor of the comprehensive monthly, which covers a wide range of Section and professional interests.

A sound movie on construction of the substructure of the Paseo Bridge over the Missouri River at Kansas City provided the program for the **Central Illinois Section's** October meeting—a joint session with the American Railway Engineering Association's Committee 15 on Iron and Steel Structures. F. R. Hoover, of the Kansas City Bridge Co., showed the film to an audience of 85.

Many questions on the corrosion of metals were answered for the benefit of engineers attending the **Cincinnati Section's** November meeting. Three films—furnished by the Corrosion Engineering Section of the International Nickel Co.—gave a graphic demonstration of the nature of corrosion, anode and cathode processes, and the origin and characteristics of corrosion currents. Prof. Roy MacDuffie, of the metallurgical department at the University of Cincinnati, conducted question-and-answer periods after each of the three presentations.

Problems involved in obtaining iron ore from taconite were discussed at the October meeting of the **Cleveland Section** by Fred M. Darner, executive supervisor of engineering for the Reserve Mining Co. Mr. Darner described the research on taconite in process at the University of Minnesota's Metallurgical Laboratory, commenting particularly on the problem of developing a drill that would penetrate the extremely hard ore. The successful drill turned out to be a kerosene-liquid oxygen torch that produces a flame of 4000 deg F. Cost of the whole taconite project, which includes a processing plant at Silver Bay, Minn., is over $160,000,000.

Lowell O. Stewart, head of the civil engineering department at Iowa State College and long-time secretary-treasurer of the Iowa Section, presents official ASCE banner to the Iowa State Student Chapter. The banner, a gift from the Section, was accepted by Chapter President Merwin Dougal.

In the featured address at the **Columbia Section's** October meeting Louis E. Rydell told of his experiences in helping the Irish Government solve its River Shannon flood problems. Mr. Rydell, who is chief of the Planning and Reports Branch of the Walla Walla District of the Corps of Engineers, went to Ireland last summer at the request of the State Department to work with local engineers and officials on the project. He said that recommendations for multi-purpose flood control, navigation, and power projects came out of his trip. A record turnout of 105 honored Mr. Rydell who was on the eve of assuming new duties as ASCE Director for District 12.

The **Hawaii Section** is already making plans for its annual conference, to be held on April 24. Russell Smith, Jr., will be chairman of the important all-day anair. The October meeting took the form of a guided tour of the Pearl Harbor Naval Base including a visit to a submarine docked there.

John S. Williams, chief engineer of the American Gilsonite Co., Salt Lake City, was featured speaker at the **Intermountain Section's** October meeting, with a talk on his company's $12,000,000 expansion program.

A spirited program on the subject of "Unions and Engineers" held the attention of a large turnout for the **Kansas City Section's** October meeting. Junior Members were in charge of arrangements consisting of a panel of three speakers. A summary of the history and development of unions, by Albin H. Schweers, of the Kansas City office of Howard, Needles, Tammen & Bergendoff, launched the discussion. Then Robert E. Vansant, of the firm of Black & Veatch, and William E. Adams, of the Burns & McDonnell Engineering Co., presented the pros and cons of unionism for professionals, explaining that they were deliberately taking opposite sides of the question for the sake of effective presentation. Elmer M. Miller of Burns & McDonnell, was the moderator.

Los Angeles' outstanding work in slum clearance and rehabilitation of blighted areas was described at a recent joint meeting of the **Los Angeles Section** and the Structural Engineers Association of Southern California. Speakers were Gilbert E. Morris, superintendent of building for the city, assisted by Harold L. Manley, assistant chief of the Building Division, Conservation and Rehabilitation. Mr. Morris explained the success of "an educating and selling program" in rehabilitating the city's 10,000 blighted blocks. He said the city has told owners what they can do and explained the benefits of improvements instead of taking them to court. Before-and-after slides showed how the city's plan is really working—an annual improvement program of up to $200,000,000 has been stimulated.

The **Maine Section** now has a **Vermont Branch,** made up of members formerly assigned to the Northeastern Section who petitioned for the change. Its already flourishing **New Hampshire Branch** gave a Life Membership Certificate to Percy Greenough at its recent annual meeting. Guest speaker for the occasion was Comdr. John Albers, officer in charge of constructing Texas Towers as offshore radar

Prominent at the annual convention of the Montana Section—held in Billings, Mont., October 28 and 29—are (in usual order) retiring Section president O. C. Reedy; Glenn W. Holcomb, Vice-President, Zone IV; Louis E. Rydell, Director, District 12; G. J. Hoge and L. F. Whearty, vice-presidents; J. Y. Barnes, new president; and D. H. Park, secretary. Messrs. Holcomb and Rydell—en route home after attending the Annual Convention in New York, where they were inducted into office—reported on the Convention. The banquet, which celebrated the Section's tenth anniversary, was attended by 150 including all but one past-president. Charles Sumner Heidel, staff engineer for the U.S. Geological Survey at Helena and first president, received a "Distinguished Professional Accomplishment Award," the first ever given by the Section. Fred G. Birch, of Great Falls, was awarded a Life Membership Certificate. Featured banquet speaker was William J. Jameson, immediate past-president of the American Bar Association, whose talk, entitled "Human Engineering," dealt with the problem of balancing personal civil liberties and national security.

stations in the Atlantic. Commander Albers dealt, particularly, with installation of the first of the man-made islands, which was recently placed off Cape Cod. DeLong jacks attached to temporary legs and having a 5,900-ton-lifting capacity were used to raise the triangular structure into position above the water. The cost of the first tower is in the vicinity of $10,200,000, while contracts for two others are expected to average $8,000,000 each.

New **Mid-South Section** officers—elected at the close of the Section's annual meeting in Memphis in October—are L. A. Tvedt, Memphis, president; Frederick R. Brown, Vicksburg, vice-president; J. Irby Seay, Jr., Memphis, director for Tennessee and Illinois; Ben T. Collier, Jackson, director for Mississippi; and Mark G. Garver, Little Rock, director for Arkansas-Missouri. Earl C. Meserve of Little Rock, starts his fourth term as secretary-treasurer. Of special interest were talks covering design requirements and facilities for the St. Louis–San Francisco Railway Company's new Tennessee yards now under construction at Capleville. P. L. Schmitz, assistant to the president of the company, and A. V. Dasburg, of the General Railway Signal Co., were the speakers. An inspection tour of the Tennessee yards concluded the three-day meeting, which also included a technical session on pipe piling for bridges and buildings; a program of student papers; and an "early bird party," luncheon and dinner.

Over 100 members of the **Nashville Section** and Vanderbilt University Student Chapter turned out in October for what proved to be one of the best meetings of the year—a guided tour through the Marquette Cement Company's test laboratories and plant. The entire operation was observed in sequence, from secondary crushing of the limestone as it comes into the plant to sacking and loading the finished product. The cement company was luncheon host to the joint group.

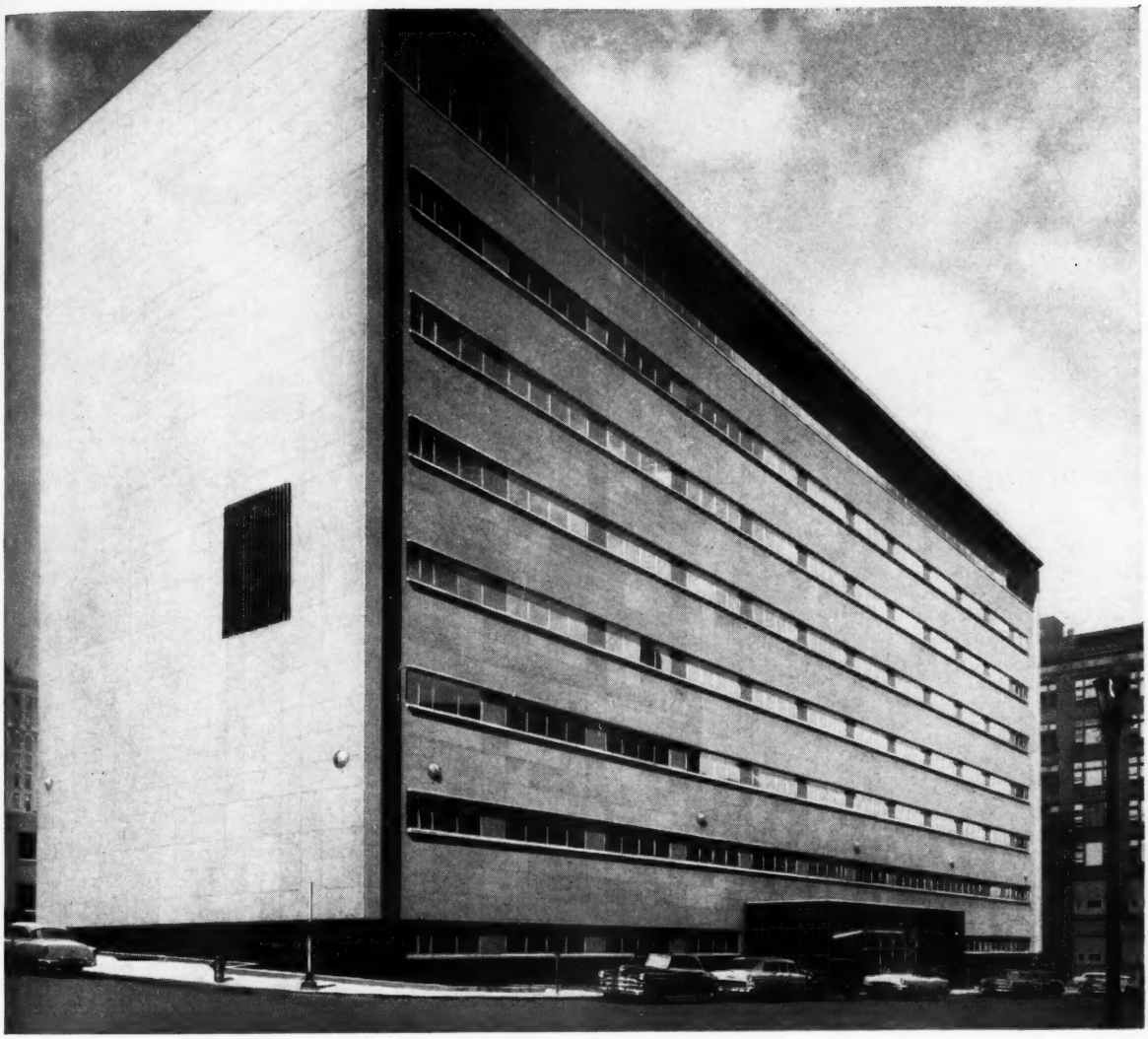
The United States is geared to a long-range program directed toward the gradual replacement of existing fuels with atomic fuels, Louis H. Roddis, Jr., deputy director of reactor development for the Atomic Energy Commission, told members of the **National Capital Section.** In the featured talk at the November meeting, Mr. Roddis described in detail five concepts of power production under study by the AEC and the arrangements that have been made with private interests to build full-scale plants to determine costs and other essential factors. Mr. Roddis emphasized that the AEC itself is not in the business of building reactors for power production—it is a research and development agency working with private business.

The **New Mexico Section** is exploring the possibility of organizing a statewide council of engineering societies. With this idea in mind, it recently sponsored a dinner meeting of representatives of the societies in the state, with E. Paul Lange, executive secretary of EJC, the guest speaker. Section officers for 1956 are Arthur A. Mosher, president; Ray J. Foss and Reuben E. Cole, vice-presidents; and Rufus H. Carter, Jr., secretary-treasurer.

Recent developments in sanitary engineering, including new methods of allocating sewage-disposal costs and a new method of treating packing-plant wastes, were highlighted at the **Northwestern Section's** October meeting. The experts were George Schroepfer and George Rohlich, professors of sanitary engineering at the University of Minnesota and the University of Wisconsin.

Oregon State Highway Engineer R. H. Baldock was featured speaker at the **Oregon Section's** October meeting. His subject was the Highway Department's projected twenty-year program of freeway and expressway development in the Portland metropolitan area.

A study of Philadelphia's public works program launched the **Philadelphia Section's** new season at a joint meeting with the local chapter of the American Public Works Association on October 11. In the leading talk Vernon D. Northrup, managing director of the city, balanced the municipality's needs against its resources. In his opinion, future needs cannot be met on the basis of the projected six-year budget of $571,000,000. As one example of its inadequacy, he said that a billion-dollar program would be required to modernize the city's transportation system alone. The **Junior Forum** is off to a good start, too, and has already met three times. At its October meeting a panel, under the chairmanship of Sol Kirschen, discussed



Architect: Ellerbe and Co.; *General Contractor:* Wm. Baumeister Construction Co.; *Fabricator:* St. Paul Structural Steel Co.; *Erector:* N. H. Sandberg Erection Co. — all of St. Paul.

THEY USED BOLTED JOINTS FOR NEW BUILDING IN ST. PAUL

This block-long structure, completed recently at Victory Square in the Loop, St. Paul, is the head office building of Minnesota Mutual Life Insurance Company. The 8-story Kasota stone building has a steel framework of 1,122 tons. The structural members are joined by approximately 22,000 Bethlehem High-Strength Bolts.

Bethlehem High-Strength Bolts are ideal for joining structural members because of the saving they make possible in erection time. They are quickly installed by means of a calibrated pneumatic impact wrench, which applies sufficient torque to provide permanently tight joints. Besides, the wrench is far less noisy than a riveting gun, making high-strength bolting particularly desirable for construction near hospitals and schools, and in other areas where noise is especially objectionable.

Bethlehem High-Strength Bolts are made of carbon steel, are heat-treated by quenching and tempering, and meet the requirements of ASTM Specification A-325.

Why not let one of our engineers explain in detail the advantages of using Bethlehem High-Strength Bolts? A call to the nearest Bethlehem sales office will bring him to your desk promptly. Or write direct to us at Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

competitive bidding from all angles. New **Trenton Branch** officers are Max O. Laird, president; Carl H. Gaum, vice-president; and H. W. Acken, secretary-treasurer.

Providence Section members, out in good number for the October meeting, heard a symposium on foundation design and construction for the Providence River Bridge. State, engineering consultants, and builders were represented on the panel of speakers consisting of Daniel O. Cargill, chief bridge engineer of the Rhode Island Department of Public Works; Francis C. Pierce, senior foundations engineer for Charles A. Maguire & Associates; and Charles L. Guild, president and treasurer of the C. L. Guild Construction Co.

In the current "Engineerogram," mouthpiece of the **Sacramento Section,** Art Gooch makes a plea for more active participation in the Section's fine Junior Forum programs. Says Mr. Gooch, "Much has been written. . . concerning the young engineer's position in his profession, his viewpoints, and what he thinks should be done. All too often, though, the position of the individual is, why doesn't someone else do something about it? The trouble is that an organization is only as strong as its membership, its active membership. . ."

The pros and cons of prestressed concrete design and construction, as compared with other types of construction, were discussed in the leading talk at the **San Diego Section's** October meeting. The featured speaker—R. C. Dorland, chief engineer of the Southwest Structural Concrete Corp.—used slides to illustrate the design of a simple beam in prestressed concrete, and showed how positive end anchors could be used to vary the magnitude of the prestressing force in the beam.

A lively program on the professional status of the engineer and how it can be improved initiated the **Syracuse Section's** first meeting of the season. Earl O'Brien, Don Stearns, C. W. O'Connell, and Bernard Dawson were among the commentators. It was the consensus of the group that the informal discussion was of such interest it should be continued at future meetings, perhaps in cooperation with other engineering groups.

The **Texas Section's** far-flung Branches are electing their 1956 officers. For the **Austin Branch** the new slate is: Seth D. Breeding, president; William R. Welty, vice-president; and W. D. Ramey, secretary-treasurer. For the **Brazos County Branch:** Wendell H. Nedderman, president; T. W. Porter, Jr., vice-president; and Edmund P. Segner, Jr., secretary-treasurer. For the **Corpus Christi Branch:** J. B. Childer, president; W. W. McClendon, vice-president; and Homer C. Innis, secretary-treasurer. For the **Dallas Branch:** J. G. Rollins, president; D. B. Granger, vice-president; and James R. Padgitt, secretary-treasurer. For the **El Paso Branch:** Lee R. Jones, president; W. H. McDill, vice-president; and John A. Ferguson, secretary-treasurer. For the **Forth Worth Branch:** A. Blan Bell, president; Ralph Hardy, vice-president; and Charles Moore, secretary-treasurer. For the **High Plains Branch:** W. R. Hogge president; M. R. Smith, Jr., vice-president; and T. E. Pollard, secretary-treasurer. For the **Houston Branch:** Leo A. Loggins, president; R. M. Collie, vice-president; and John A. Focht, Jr., secretary-treasurer. For the **Paris Branch:** C. C. Cagle, president. For the **San Antonio Branch:** Charles Praeger, president; John D. Stockton, vice-president; and William Gerhardt, secretary-treasurer. For the **San Jacinto Branch:** W. A. McElhannon, president; W. D. Broyles, vice-president; and A. M. Braswell, Jr., secretary-treasurer. For the **Southeast Branch:** W. P. McGee, president; A. J. Stocker, vice-president; and Jack D. Morris, secretary-treasurer; and for the **West Texas Branch:** M. T. Rowland, president; Jack B. Collins, vice-president and K. R. Short, secretary-treasurer.

Recent **Toledo Section** programs have included an inspection tour of a fourteen-mile stretch of the Ohio Turnpike, prior to official opening of the whole trans-state facility; a talk on recent building code revisions, by Raymond C. Reese, local consultant; a talk by Dean Harrison, of the University of Toledo, on developments in navigational devices and aids; and an illustrated talk on construction of the Mackinac Bridge by A. L. Bentley, Jr. The Section will be host to the next meeting of the District 9 Council at the Hillcrest Hotel in Toledo sometime in April.

Coming Events

Central Illinois—Regular meeting at the University Women's Club in Urbana on December 20.

Maine—Annual Highway Conference at the University of Maine, Orono, December 16 and 17. The **New Hampshire Branch** is sponsoring a Highway Conference at the University of New Hampshire, Durham, December 17.

Metropolitan—Meeting in the auditorium of the Engineering Societies Building, New York, N. Y., December 14, 7:00 p.m. Meeting of the **Junior Branch** in Room 502, Engineering Societies Building, January 4, 7:00 p.m.

National Capital—Annual Christmas Party at the Cosmos Club, Wednesday evening, December 28.

Philadelphia—Joint meeting with local groups of ASME and AIEE at the Benjamin Franklin Hotel, December 12, 7:30 p.m. (dinner at the Engineers Club at 6:30). Regular meeting at the Engineers Club, January 10, 7:30 p.m.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday at 12 noon. Meeting of the **Central Valley Branch** on December 21.

South Carolina—Annual winter meeting—a joint session with the South Carolina Society of Engineers—at the Columbia Hotel, Columbia, January 13. Registration will start at 10:00 a.m., and the program will include morning and afternoon technical sessions, business meeting, luncheon, social hour, banquet, and entertainment.

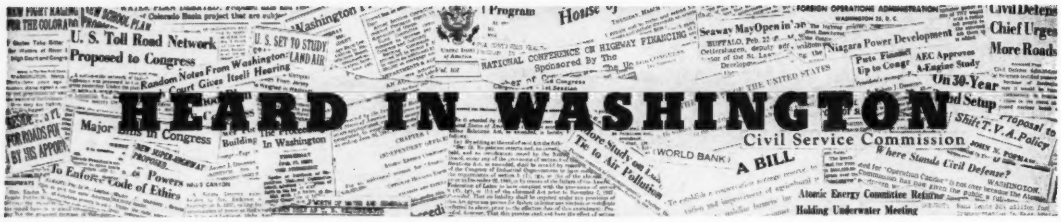
Texas—Meetings of the **Dallas Branch** at the Hotel Adolphus the first Monday of each month at 12:15 p.m.; meetings of the **Fort Worth Branch** at the Hilton Hotel the second Monday of each month at 12:15 p.m.; meetings of the **Houston Branch** the third Tuesday of each month; meetings of the **San Antonio Branch** the second Monday evening of each month; and meetings of the **Southeast Branch** the last Saturday of each month.

Scheduled ASCE Conventions

DALLAS CONVENTION
Dallas, Tex.
Hotel Baker
February 13–17, 1956

KNOXVILLE CONVENTION
Knoxville, Tenn.
University of Tennessee
June 4–8, 1956

PITTSBURGH CONVENTION
Pittsburgh, Pa.
William Penn Hotel
October 15–19, 1956



JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Much unfinished business faces Congress when it reconvenes on January 3, 1956.

Two measures that have made progress toward passage would, if finally enacted, ultimately benefit professional engineers to the extent of some millions of dollars.

Individual Retirement Bill

H. R. 10 provides for an **individual retirement plan** for self-employed professional men. Up to 10 percent of yearly earnings would be tax-exempt if invested as provided in the bill to create an individual retirement fund. ASCE has cooperated with the American Bar Association, the American Medical Association, and other leading professional groups in supporting the proposal. The measure met with a cold reception in the 83rd Congress when Engineers Joint Council, with the authorized support of ASCE, first testified (1953) in its support. At that time the Treasury Department condemned it in no uncertain terms. It has, however, long been recognized that laws which permitted corporations to pay pensions to employed executives under favorable tax treatment, but denied independent practitioners the same treatment, were discriminatory. This year in the 84th Congress, testimony of the engineering and other professional societies was very cordially received by the Committee. In addition, the Secretary of the Treasury conceded the basic justice of the measure, voicing the practical objection that the tax loss of an estimated billion dollars a year was too great.

The Ways and Means Committee of the House of Representatives gave its approval to the bill, which means that it probably will be incorporated in a package tax measure to come before the House in the coming session. In an election year, tax-reduction measures are popular, subject only to the desire for balancing the budget.

Federal Salaries

Government salaries have been an important concern of the Society. H. R. 7619, which passed the House of Representatives late in the last session, would radically alter the compensation of top government officials. It would raise salaries of some agency chiefs and other key officials to $20,000 and over. Salaries of fifty-six others would be raised to $19,000 and those of another group to $17,500. This would seem to be the first step in a series needed to bring adequate compensation to our members in government employ.

ASCE supported the recently passed **classified-pay bill,** which provided some pay increases. With a statutory limit of $14,800 on the top grade, it has been impossible to compensate properly in the upper grades. Obviously if a $50,000 a year executive accepts a government job at $15,000, it is impossible to pay men worth $15,000 a year a proper salary. If salaries of the bosses can be raised, the way should be open for a revision of the whole classified pay scale, especially in the upper grades. This would provide incentive for high-caliber graduates to enter government service by offering rewards for accomplishments and long service. The several steps may take some years to complete, but this bill offers the first ray of hope to those in government to receive compensation somewhat comparable to the market value of their services.

Several studies of the **government's need for engineers** and the extent to which they fail to enter or remain in federal employ by reason of the compensation paid in corresponding private work will be considered in the study of **Bill S. 688** now before the Senate.

S. 890—to extend and strengthen the **Water Pollution Control Act**—which has passed the Senate, will be the subject of further hearings in the House. Local sanitary officials recommend certain language changes in the sections relating to grants-in-aid and enforcement procedures. Indications are that legislation will be enacted. The Commission on Intergovernmental Relations in its final report recommended that the states should improve pollution control laws; that the federal government should provide technical and financial assistance; and that the desirability of financial assistance for construction of facilities should be studied.

Hoover Commission

Most recommendations relate to dollar savings in government operations. In the matter of research and development, economies are not suggested. White House conclusions on the Hoover Commission recommendations may come soon, following study of the reports by an Advisory Committee headed by Nelson Rockefeller and review by Meyer Kestnbaum, Special Assistant to the President.

Bills covering many separate recommendations have already been referred to nine Senate and eleven House Committees. No bills relating to the Commission's recommendations on the controversial subject of water resources, or on Overseas Economic Operations have as yet been introduced.

The Citizens Committee for the Hoover Report, 441 Lexington Avenue, New York 17, N. Y., has prepared digests of the nineteen commission reports which are available at 10 cents each or $1.50 for a bound volume of digests of all the reports.

Washington, D. C.
November 17, 1955

NEWS BRIEFS . . .

Construction Next Year Should Top 1955 Record

New construction expenditures may reach a record-breaking total of $44 billion in 1956, 5 percent above the $42 billion peak indicated for 1955, according to joint estimates of the Commerce and Labor Departments. Substantial gains are anticipated in private nonresidential and public construction. New housing, although slightly below this year's volume, is expected to continue at a high level.

These 1956 estimates are based on the assumption of a moderate increase in overall economic activity. They reflect, also, the tremendous volume of construction now in progress, much of which will be carried over into the new year. Construction costs are expected to continue to rise moderately. Increased plant capacity and rising productivity will prevent all but minor or spot material shortages. It is assumed that investment funds will be adequate to underwrite the estimated level of both private and public construction.

Private construction outlays in 1956 are set slightly above the 1955 total of $30 billion. Public construction, which in recent years has increased steadily but more slowly than private work, is expected to rise 10 percent in 1956—to more than $13 billion.

Private nonfarm housing starts in 1956 are estimated at about 1,200,000 units—100,000 fewer than in 1955 and 200,000 less than at the 1950 peak. The expected 1956 decline in housing starts had its origin in the latter part of 1955 when funds became relatively scarce for long-term, low down-payment mortgages at low interest rates, thus affecting the financing of homes to be started early next year.

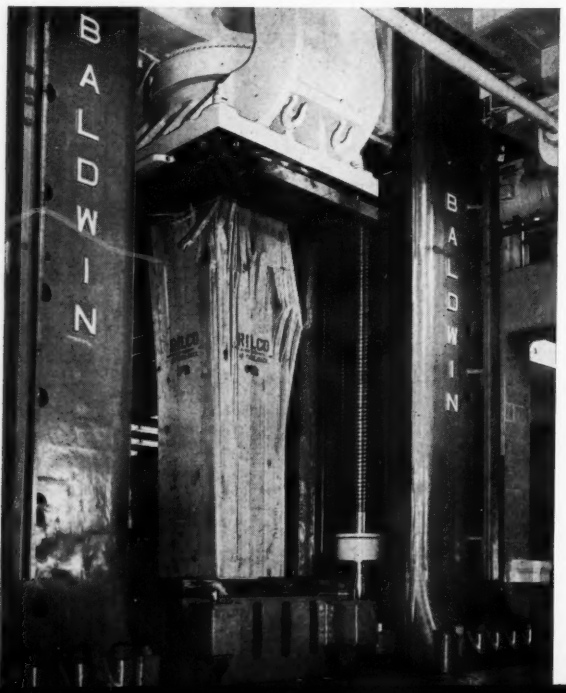
Most of the increase in private construction between 1955 and 1956 is anticipated from the rise in expenditures for new nonresidential buildings to $8.7 billion—with industrial building showing the largest relative gain. Some of the construction will be in the nature of plant modernization to cut costs and keep pace with technological change.

Probable 1956 expenditures of $2¼ billion for stores and other service establishments—many in new suburban developments and along expanding highway networks—are 17 percent above the 1955 total and 80 percent above that for 1954. A record $850 million is in prospect for religious buildings in 1956. New construction expenditures of privately owned public utilities in the coming year are expected to remain near the 1955 level of $4½ billion, with substantial increases in the construction programs of railroads and telephone and telegraph companies offset by decreased activity on the part of electrical and gas companies.

The outlook for most types of public construction in 1956 is for a rise of about 10 percent over 1955 expenditures with gains in all major categories. During the postwar period state and local governments have been faced with a growing backlog of construction needs despite increasing outlays for new projects. Requirements are especially pressing for highways, schools, and sewer and water facilities. It is estimated that these three types of facilities will account for fully three-fourths of the rise in public construction expenditures in 1956, and each will reach a new record level. Power and other facilities in connection with the St. Lawrence Seaway account for a large share of the increase in state and locally owned miscellaneous public service projects between 1955 and 1956. Expenditures for public housing and conservation and development work are expected to increase in 1956 for the first time in several years.

Work Starts on Ohio River Locks Project

Construction of a new 1,200-ft-long and 110-ft-wide Ohio River lock has been started by the Savin Construction Corp., of East Hartford, Conn., under a $16,312,765, low-bid contract. The present lock is part of the Army Corps of Engineers New Cumberland Locks and Dam Project, which will eliminate Ohio River Locks 7, 8, and 9 and provide a pool 23 miles long.



World's Largest Universal Testing Machine at Lehigh University

Dominant feature of Lehigh University's new Fritz Engineering Laboratory, dedicated in October (November issue, page 112), is this universal testing machine, largest in the world. Designed and built by the Baldwin-Lima-Hamilton Corp., Philadelphia, the machine is capable of applying both tensile and compressive loads up to 5,000,000 lb. Six load ranges, from 20,000 lb up, are available. Machine has a total height of 76 ft (60 ft above and 16 ft below test floor level), and weighs approximately 925,000 lb. Here it is shown testing to destruction (at 4,840,000 lb) a 30 by 30-in. by 10-ft section of a glued laminated structural member in compression parallel to grain.

NCSBEE Elects New Officers At 34th Annual Meeting

New officers of the National Council of State Boards of Engineering Examiners, elected at the organization's recent 34th annual meeting, are Bruce Williams, Joplin, Mo., president; Edward R. Stapley, M. ASCE, Stillwater, Okla., president-elect; L. E. McCartt, Covington, Ky., director for the Central Zone; and W. H. Larkin, New York, N.Y., director for the Northeast Zone. T. Keith Legaré, of Columbia, S.C., continues as executive secretary.

The meeting, which was held in Washington, D.C., October 20–22, was the best attended in the history of the Council, with 225 delegates from 46 states, the District of Columbia, Alaska, and Canada. ASCE was represented by Joseph H. Ehlers, its Field Representative.

In the featured address at the annual banquet Maj. Gen. Charles G. Holle, M. ASCE, Deputy Chief of Engineers for Construction, hailed the Board as "one of the strongest stabilizing influences in the profession today." Without it, he said, "the problem of professional standards might well have become a runaway problem long ago." General Holle grouped the principal functions of engineers under two headings—"the economic function and the function of national defense." As to the economic function, he said that while "the engineer is not the sole, nor necessarily the highest, contributor to human betterment in modern society, by his dominant part in providing its economic base, he largely supports all other contributors." The engineer's role in defense, he sees as being able to resist today's aggression consisting "basically of the most advanced technology applied to the purposes of conquest and subjugation . . . with at least equally advanced technology . . ."

Government and Industry Discuss National Standards

Thomas B. Pike, Assistant Secretary of Defense, Supply and Logistics, pleaded with American industry to develop a comprehensive set of national standards. This can only be done, he said, by close cooperation of government and industry in standards work.

In the keynote address at the Sixth National Conference on Standards—sponsored by the American Standards Association in Washington, D.C., October 24–26—Secretary Pike pointed out that increased standardization in producing weapons and their military hardware would save taxpayers "mountains of money" and added that more industrial standardization is a vital need. Without it, he said, the national safety will be jeopardized. He also warned that the United States is rapidly becoming a "have not nation" in a number of raw materials, which "we cannot go on wasting for want of national standards."

Development of common industrial and military standards among Britain, Canada, and the United States "as a means of survival of our people" was asked by James G. Morrow, of the Steel Company of Canada, Ltd., at the Award Dinner. Mr. Morrow received the Standards Medal of the ASA. In the same ceremonies Harold S. Osborne, recently retired chief engineer of the American Telephone and Telegraph Co., was awarded the Howard Coonley Medal for "great service in advancing the national economy through voluntary standards."

Lewis Ortega, of the Division of Economic Research, Organization of American States, told the conference that the implementation of a standards program of the 21 American republics would have tremendous significance for the more than 300,000,000 people of these countries. "Trade figures show that Latin America depends to a large extent on United States goods and services, and absorbs a large proportion of United States exports. In 1954 Latin American purchases from the United States amounted to $3,371,000,000, which is equivalent to one-fourth of the total United States exports," he said.

The 1,500th American standard has just been approved, it was announced by George F. Hussey, Jr., Vice-Admiral, USN (retired) and managing director of the ASA. This is double the number of American Standards in use in 1948, he disclosed. More than 800 representatives of government, industry, and the military attended the three-day conference.

Highway Engineers Meet in Rome

The "All roads lead to Rome" theme was much in evidence in the seventy-odd papers presented at the second world meeting of the International Road Federation, held in the Eternal City, October 1–9. The papers, which had been preprinted, were only reviewed during the meeting, giving time for maximum discussion of the three major sections of the program—Social and Economic Aspects of World Road Construction, Financing, and Technical Training.

Meeting highlights included a dinner, with Representative George Fallon, chairman of the Congressional Subcommittee on Roads, delivering the keynote address. Mr. Fallon reiterated the urgent need for a two-party drive to put the President's multi-billion-dollar highway program through the next session of Congress. He asked other nations to keep step with this plan.

The Australian delegate suggested that by anticipating a network plan ten to twenty years in advance, planners could save much in real estate cost by buying rights of way before land values rose. He also offered a resolution not to divert road revenue to any other outlet. Southern Rhodesia suggested looking for new sources of revenue and urged a land tax on the property whose value is increased by new roads. Almost unanimously the toll road was deplored for world areas on the ground that road financing should come neither from tolls nor loans but "from taxes alone."

ASCE members taking part in the meeting were F. L. Brown, Brown & Blauvelt, New York; B. Chandler, Oregon State Highway Commission; C.D. Curtiss, U.S. Commissioner of Public Roads; George Kelcey and E. L. Worthington, Edwards, Kelcey & Beck; C. Nolan, U.S. Department of State; F. E. Twiss, director of engineering, I.R.F.; and T. W. VanZelst and M. D. Morris, of Soiltest, Inc.

[Mr. Morris represented ASCE at the meeting and provided the report from which this write-up was prepared.]

Gathered in Rome for second meeting of International Road Federation are 1,000 engineers from 46 countries.

Australian Bridge Features Use of High-Tensile Bolts for Field Connections

View of superstructure erection shows four of the ten 250-ft spans in position. All but first are being erected as full cantilevers from pier to pier.

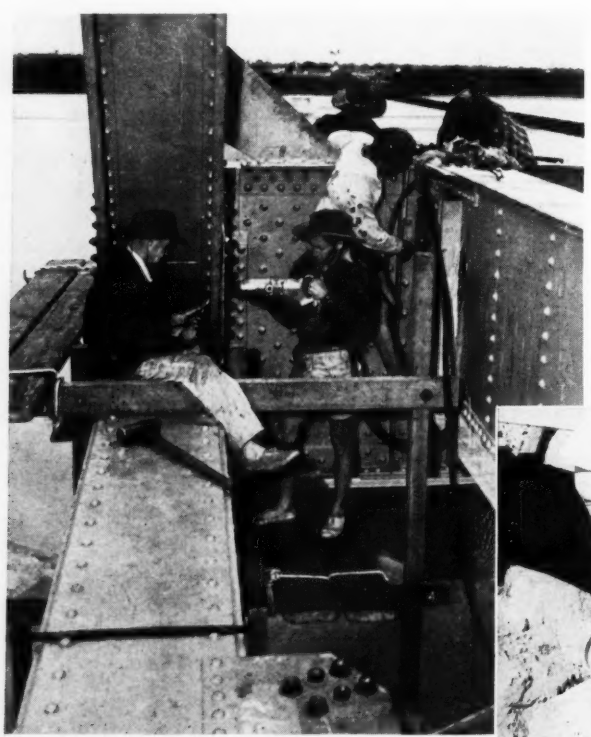
A high level combined rail and highway bridge now being erected at Home Hill in North Queensland, Australia, consists of structural steel spans aggregating 3,620 ft of bridging and containing approximately 7,000 tons of fabricated steel. The crossing of the half-mile-wide river channel, which carries a maximum flood discharge in excess of 1,000,000 cfs, is effected by ten 250-ft Pratt-truss spans. Except in a few minor instances, field connections throughout are being made with high tensile bolts in place of the customary hot-driven rivets.

Procedure at the bridge site, where bolting-up commenced in August 1954, follows very closely methods in use on larger American jobs. Bolts are torqued with the aid of Models I-R 514, 518, and 534 impact wrenches, torque-control being secured by running the wrench "to stall" on a predetermined air pressure. Average time for screwing up is 15 to 20 sec per bolt. In general, wrenches are calibrated daily to establish and confirm the pressure-torque relationship for each wrench. The torque-tension relationship for the bolts as supplied was determined and proved to follow closely that reported in American research programs; application of a torque wrench to a small proportion of the bolts selected at random is considered to provide a sufficient check. Maintenance on impact wrenches has been heavy and service life of sockets unexpectedly short. Investigations to correct these difficulties are proceeding. Approximately 300,000 bolts were required to complete the job.

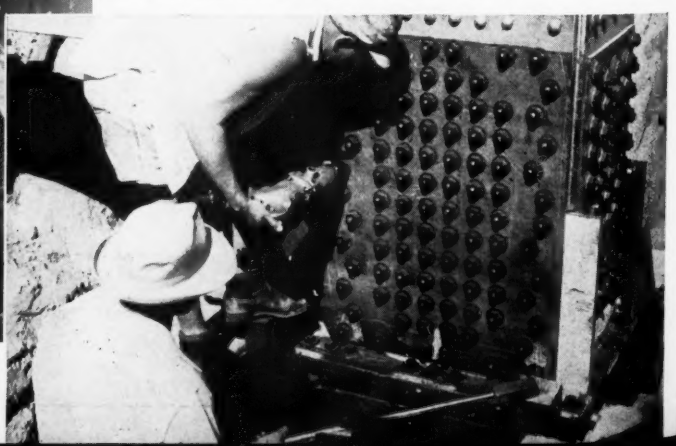
The decision to use high-strength bolted connections was made in 1949, after reading early published results of the research program under way in the United States. Information has been supplied by the Industrial Fasteners Institute; Purdue University; the American Institute of Steel Construction; the Bethlehem Pacific Coast Steel Corp.; and Ingersoll-Rand (Australia) Pty. Ltd.

Bolt specifications were modeled closely upon "Specifications for Assembly of Structural Joints Using High Tensile Bolts," approved in January 1951 by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation. The bolts are obtained from local sources.

[This write-up was prepared from notes on the project submitted by J. A. Holt, Coordinator General of Public Works, Brisbane, Australia.]



In left-hand photo high-strength bolts are being placed in a cross-girder end connection. Impact and torque wrenches are seen in screwing-up process (bottom view).



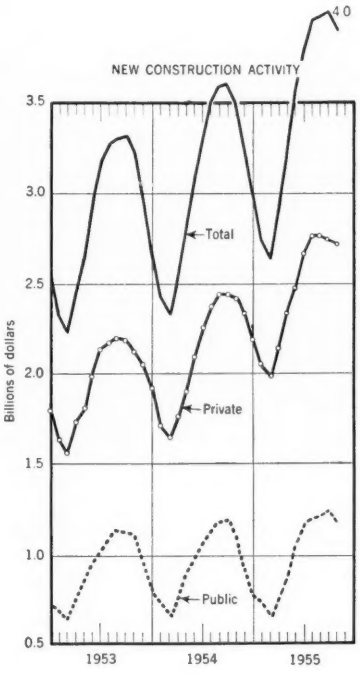
October Construction Activity at Peak for Month

Although spending for new construction declined seasonally in October to $3.9 billion, it was 11 percent above the previous peak for the month set last year, according to preliminary joint estimates of the U.S. Departments of Commerce and Labor.

On a seasonally adjusted basis, construction activity this October has been at rates which indicate that 1955 expenditures for new construction will total approximately $42 billion—topping last year's record $37.6 billion by more than 10 percent. Actual expenditures for the first ten months of 1955 were 13 percent higher than in 1954.

Reduced residential building was the largest single factor in the 3 percent decline in private construction expenditures over the month. Curtailed outlays by homebuilders in October resulted primarily from the September drop in housing starts. On the other hand, private commercial and industrial building continued to expand, breaking all previous monthly records.

The 5 percent decline from September to October in public construction expenditures was on state and local government projects. Highway construction declined seasonally from its all-time peak in September, and public school building tapered off after setting new records in August and September. Federal construction activity continued at about the same rate as in the previous two months, which was well below last year's levels except for military projects. Continuing expansion of Air Force facilities pushed outlays for military construction in October to as high as they were at their 1952 postwar peak.



Despite seasonal decline in new building, construction expenditures in October (at $3.9 billion) were 11 percent above previous peak for the month set last year.

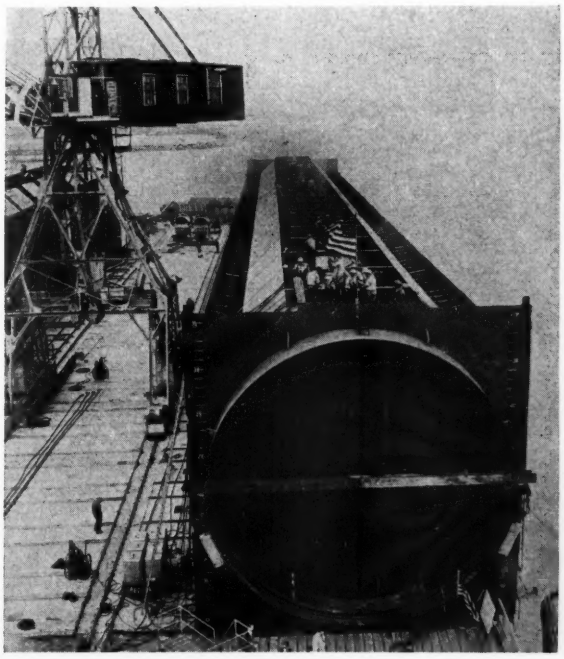
Sewage Reclamation Studied at Caltech

Next to smog, water shortages present the most serious challenge to the ultimate growth of Southern California. This warning was sounded by J. E. McKee, M. ASCE, associate professor of sanitary engineering at California Institute of Technology. Reporting on a year's research in sewage reclamation in the October issue of the Caltech alumni magazine, Dr. McKee said that, in twenty or thirty years, the area's water requirements will be more than twice the available supply from present sources.

Since the development of an economic method for the disinfection of waste water seems the best hope of getting additional supplies, Caltech engineers are concentrating on the problem of sewage reclamation. "The public is naturally reluctant to use reclaimed sewage," Dr. McKee stated, "and a long period of education will be necessary to establish its merits. Actually, sewage is over 99.90 percent pure, and is still fresh water containing less than 1,000 ppm by weight of solids, in contrast to sea water which has about 35,000 ppm."

All sewage must be treated somewhat before it can be discharged into the land or sea, Dr. McKee said. It is estimated that an additional $20–35 per acre-ft would be the cost of reclamation. This, compared with a cost of $125 to $150 per acre-ft for the separation of fresh water from sea water, indicates the need of finding "cheaper, safer, and more efficient ways to reclaim and reutilize sewage and other wastes."

Tunnel Section for Hampton Roads Crossing Is Launched



One of the 23 huge double-shell steel casings that will make up the tunnel part of the 3.5-mile bridge-tunnel project now under construction across Hampton Roads is being launched in the Delaware River for towing to a "shape-up" station at Lamberts Point, Norfolk, a few miles from the tunnel site. The 300-ft-long watertight sections are being built by the Baldwin-Lima-Hamilton Corp. for Merritt-Chapman & Scott, the general contractor. Major jobs on the multi-phase project include fitting out and placing the 23 tube sections; sinking them into a prepared trench and covering; and building two artificial islands and two low-level connecting bridges. The 6,860-ft underwater part of the project is the eleventh trench-type tunnel to be built in the United States. The $19,050,461 crossing is the major feature of a 23-mile Tidewater area project, described by the Virginia State Highway Department as the largest in its history. Parsons, Brinckerhoff, Hall and Macdonald are the engineers.

Depth-Recording Device for Underwater Construction

The Hudson River crossing of the Tennessee Gas Transmission Co., from Piermont to Dobbs Ferry, N.Y., is providing the first commercial test of the Survey Depth Recorder, a new lightweight, single-transducer echo sounder manufactured by the Edo Corp., College Point, N.Y.

Installed in the wheelhouse of the *Mary King*, a 38-ft workboat owned by the Shultz Dredging Corp. of Hoboken, N.J., the Edo Depth Recorder is making possible a continuous, minutely accurate record of trench-digging progress through the Hudson's mucky bottom.

In contrast to old-style electronic depth sounders, which were extremely bulky, took up a great deal of space, and required the cutting of holes in the hull for the installation of multiple large transducers, the new Edo equipment (including its single 15-lb transducer), weighs a total of 75 lb, measures $18^1/_2 \times 13^1/_2 \times 9^1/_2$ in. and can be mounted permanently or temporarily on a simple bracket. Its price of $2,740 (including portable power converter) is also unparalleled in the field.

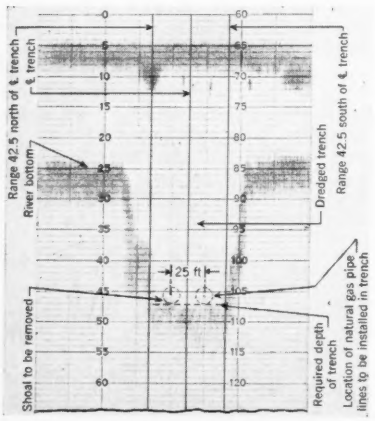
When completed, the Hudson River project will furnish a third source of natural gas from Texas fields to the metropolitan New York area. On this project, according to Ralph Atwater, general manager of Shultz Dredging, the Edo Depth Recorder is proving invaluable at all three stages of the work—in the preliminary survey of the river bed, in the actual dredging (being carried out by Shultz and the American Dredging Co.), and in the backfilling which will follow the placing of the pipes in the trench.

The accompanying graph shows how clearly subsurface contours of the Hudson show up on the Edo Depth Recorder's electro-sensitive graph paper. The Survey Depth Recorder has eight ranges which permit the user by the flick of a switch to chart depths from 0 to 70 ft or fathoms, 60 to 130 ft or fathoms, 120 to 190 ft or fathoms, or 180 to 250 ft or fathoms.

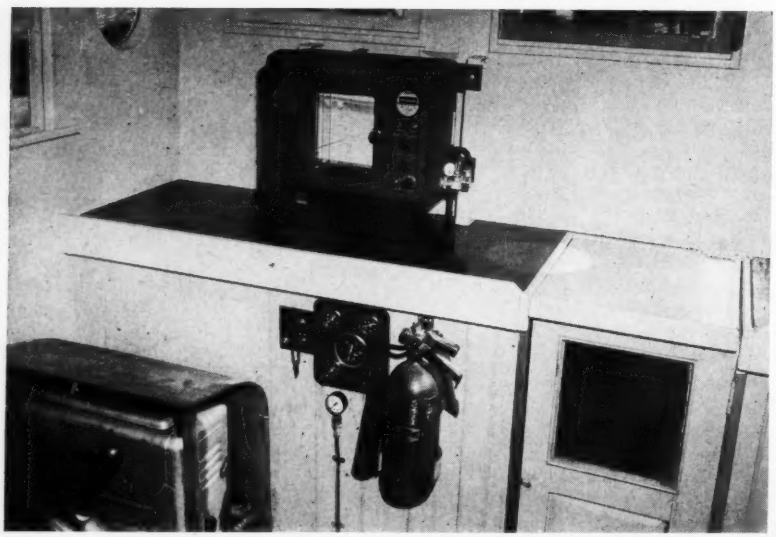
"Recorder readings are so definitive," Mr. Atwater says, "that when the pipeline is laid we'll be able to detect with the recorder the outlines of the individual pipes." Meanwhile, continuous use of the recorder over work in progress instantly shows up inaccuracies in the dredging. A marker button enables the user to show on the graph the location of ranges or stations as the survey boat changes its position. In addition, the user can by means of triangulation, stadia, or sextant determine the exact position of the survey boat and thus make the recorder readings of permanent value.

A single roll of the graph paper, which is light in color, dry, and unaffected by light or atmospheric conditions, lasts for 10 hours of continuous operation on the foot-scale and 20 hours on the fathom-scale.

While the Edo Depth Recorder now in use on the *Mary King* is the first commercial installation of the equipment, the recorder has already been put to extensive use by the U.S. Navy Hydrographic Office, the U.S. Coast and Geodetic Survey, and the U.S. Army Engineers in the year since its introduction by the Edo Corp.



Survey Depth Recorder installation in wheelhouse of the "Mary King." Dredging in progress in the Hudson River crossing, as indicated by the recorder, is shown in small photo.



Sanitary Landfills Proposed For Los Angeles County

Construction and operation of a sanitary landfill by the Los Angeles County Sanitation Districts has been recommended as the most feasible solution to the serious refuse-disposal problem facing Metropolitan Los Angeles. This recommendation is made in a report prepared for the Board of Directors of the County Sanitation Districts by the office of A M Rawn, M. ASCE, chief engineer and general manager of the Districts.

The report notes that the phenomenal growth of Los Angeles County during the past two decades has "outmoded current unorganized local methods of refuse collection and disposal." Not unnaturally, it finds that the cheapest disposal means available has been used—hog feeding of raw garbage and home incineration of combustible rubbish. Non-combustible rubbish is being collected from residences and places of business by private operators and disposed of, almost without exception, in privately owned and operated landfills.

Within the past five years, the report notes, Metropolitan Los Angeles County has become too acutely conscious of "(1) the spread of disease among hogs fed uncooked garbage, with its resultant effect upon community health and the lowering of the state's animal husbandry economy, and (2) the increasing danger of air pollution. . ." to permit continuing in the status quo. This changed situation and changes in Metropolitan Los Angeles community life indicate that "organized public agencies, supported by public law, must enter the picture to supplement the . . methods of refuse collection and disposal offered by the entrepreneur."

The report emphasizes that the proposed plan is not aimed at excluding owners and operators of private landfill sites from continued activities, or at interfering with present collection methods in any way. It presents a plan for "(1) purchasing and implementing a number of refuse-disposal sites within the existing Districts and fairly close the the Metropolitan area; (2) the construction of refuse transfer stations; and (3) a longer-range plan designed to carry on with present known methods of refuse transfer and disposal when existing facilities have been exhausted. . ."

An article describing the program in more detail will be published in an early issue.

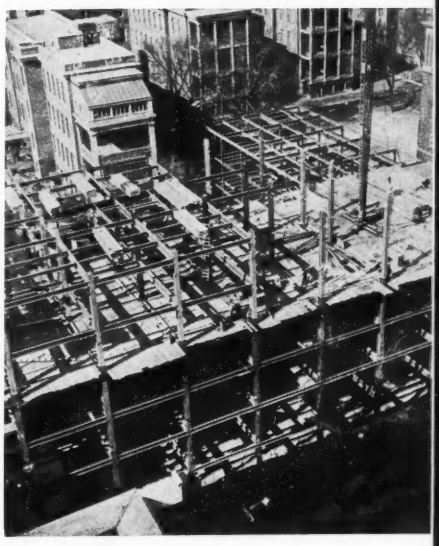
Ultrasonic Tests for Welds on Toronto Hospital Project

Toronto's best-known hospital, the Toronto General, is undergoing a $20,000,000 building expansion that will almost double its present facilities. The project includes a one-story students' building, a two-story south block, and a large 15-story center block joined to the other two structures by two-story wings. The 2,900 tons of steelwork is being completely shop and field welded.

After several months of experimentation with various types of non-destructive weld tests, the consulting engineers, Wallace-Carruthers & Associates, specified the use of ultrasonic testing. The experiments were carried out by Canadian Inspection & Testing Co., Inc.

The application of ultrasonic testing to the welded joints on the project is believed to be the first of its kind in Canada. A special lightweight portable apparatus manufactured in Great Britain by Kevin-Hughes was selected as being most suitable for working on open steelwork high above ground level. It is easily carried by one man and operates on power generated by a small unit on the ground. With proper training the operator can distinguish porosity, slag inclusions, and cracks, and determine the extent of such discontinuities in the weld metal.

The expansion project will provide enlarged facilities for both diagnosis and treatment. The center block, for instance, will contain 21 new operating rooms complete with the latest equipment including closed-circuit TV. The project will also add nearly 450 beds to the hospital's capacity.



New $20,000,000 Toronto General hospital expansion program currently being carried cut will double the present facilities of that institution.

Portable ultrasonic testing device is used to distinguish weld imperfections on Toronto hospital expansion project.

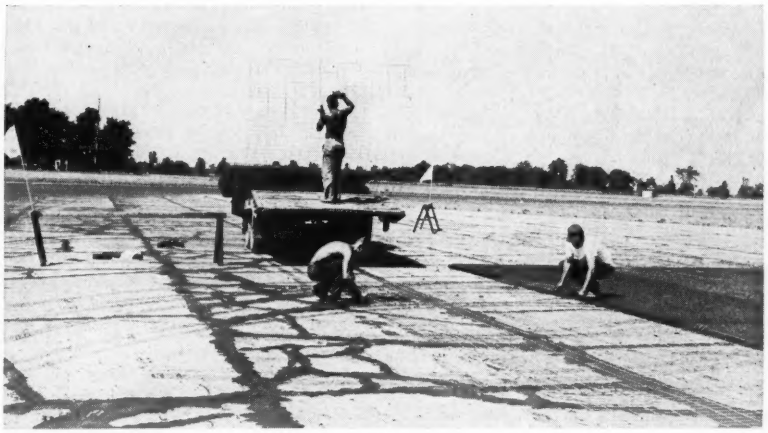
Nebraska to Have Atomic Power Plant

A revised proposal of the Consumers' Public Power District of Nebraska to build a nuclear power plant has been approved by the Atomic Energy Commission in principle as a basis for negotiations. Contract details will be subject to AEC review and approval when negotiations are completed.

Under the Power Demonstration Reactor Program, the public power group proposes to build a sodium-cooled, graphite-moderated nuclear power plant of 75,000-kw net capacity, to be completed in 1959. According to the proposal, development and design phases of the project will be carried out by North American Aviation, Inc., which is under contract with the AEC on the development of a sodium-graphite experiment at Santa Susana, Calif. The AEC believes that development of a full-scale reactor of this type will be a major contribution to the advancement of nuclear reactor art. Under the terms of the present proposal, the AEC will pay a fixed amount towards the cost of the plant, but will retain title to the parts so financed. The District will operate the entire plant.

The objective of the Power Demonstration Reactor Program is to encourage widespread participation (of industry, especially) in the development of nuclear power technology, and to work toward the time when nuclear power will become economically competitive.

Detroit Airport Pioneers Use of Welded Wire Fabric



Workmen place welded wire fabric on west ramp of Willow Run Airport, Ypsilanti, Mich., first airport in the country to use the process for a major resurfacing project. The 3,500-ft west ramp and the half-mile-long center taxiway are being resurfaced with 3 in. of reinforced asphaltic concrete to extend the life of the original pavement and increase its ability to carry today's heavy plane loads (up to 75,000 lb per single wheel). Edges of the 9 1/2-ft-wide fabric sheets are offset about 3 ft from the longitudinal joint between original portland cement concrete slabs assuring reinforcement of all longitudinal joints across the ramp. The original pavement—built in early World War II years as part of the immense Willow Run bomber plant—is 6 to 8 in. thick. Because of steel shortages it was not reinforced, with the result that, in certain areas, the 10 by 20-ft slabs have broken into smaller sections and many corner cracks have formed. Wire Reinforcement Institute photo.

Citric Acid Cuts Evaporator Scale

Scale in sea water evaporators can be controlled and production maintained indefinitely by frequent descaling with citric acid, according to a report of the Army Corps of Engineers released to industry by the Office of Technical Services, U.S. Department of Commerce. Immediate descaling with citric acid in hot brine was found to return a machine to operation within an hour. The use of citric acid increased production twenty-fold, permitting runs of up to 10,000 hours without descaling.

Detailing of the process, with illustrations of equipment, are given in *Water Treatment, Prevention of Scale in Sea Water Distillation*, which may be ordered from OTS, U.S. Department of Commerce, Washington 25, D.C. The report contains 130 pages, and is priced at $3.25.

N*G*Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"Yippy!," yipped Joe Kerr.

"Cackling, or crowing?" asked Professor Neare.

"Both. Over my invention. It's simple, like a safety-pin. So simple that Cal Klater wouldn't think of it. But it works. It worked the Yippy problem in 40 min. Cal couldn't. Cal . . ."

"Take it easy, Joe. Take a deep breath and start right at the beginning. You did what first?"

"Well, Cal had reduced the Yippy problem to 11 equations [September issue, page 86] like

$$6x - a - b - c - d - e - f = 6 \quad . (1)$$

which he said he could solve with determinants, which is the hard way. I invented an easier way by reducing to the form

$$x = 1 + \frac{1}{6}(a + b + c + d + e + f) \quad . . . . (2)$$

I set up a table listing the unknowns in Col. 1 and a wild guess at the value of each in Col. 2:

1	2	3	4	5	6	7
x	10	−.167	−.056	+.014	−.003	9.788
a	10	−.5	+.056		−.001	0.556
b	9	+.333	+.028	+.005	−.003	9.363
c	9	+.167		−.005	−.002	9.160
d	9		−.028		−.002	8.970
e	8	−.333	+.028	−.005	−.001	7.689
f	8			−.014	+.002	7.988
g	8	+.167	−.028	+.014		8.153
h	8	+.167	+.056	−.009	+.001	8.215
i	8		−.056		−.003	7.941
j	8	−.167		+.005	−.002	7.836

Substituting these guesses in Eq. 2, $x_1 = 1 + \frac{1}{6}(10 + 9 + 9 + 9 + 8 + 8) = 9.833$, so I entered −.167 as a correction in Col. 3 and figured similar corrections for the other unknowns. Then, instead of computing second approximations from the first, I figured second corrections like $x = \frac{1}{6}(-.5 + .333 + .167 - .333) = -.056$, and entered these in Col. 4. Repeating, Cols. 5 and 6 show convergence and Col. 7 is the sum of the first guess and all corrections. I went just far enuf to be sure that the average pot would be 9.788 dimes, or 98 cents."

"Just as pretty as the Bums outrushing the Yanks," conceded Cal. I don't mind telling Joe I spent 5 hr reducing two 11-rank determinants to find X = 11645514/-1190509 = 9.78196, but I wish he'd tell me why each of his 'wild guesses' is the nearest integer to the answer!"

"Yippy," yodeled Joe.

"Apparently an inventor's secret," said the Professor, "but his system will still work if his guesses are all zero, and it can be carried to any desired precision. The invention is really just a new application, like using the analogous safety-pin on an 11-fold diaper.

"Games of pure chance, like Yippy, are ready-made problems, but games of skill, like checkers, have to be adapted by some arbitrary measure of skill. For example, Anne, Beth and Claire took turns sitting out while the other two played, and results of a long series of games showed that the chance of a player's winning was proportional to her age. If Beth wins 30 percent of the games and Anne wins half as many as Claire, who is 27, how old is Anne?"

[Joe and Cal were entirely fictional. Equal or better solutions were received from Sauer Doe (Marvin Larson) and Ed C. Holt Jr., patterned after Southwell and Gauss, respectively.]

NUCLEAR NOTES

XVI—Human Tolerance to Radiation

A brief discussion of types of ionizing radiation, common sources of radiation, the interaction of photons with matter and materials used in gamma-ray shielding was given in the November installment. This part will cover the tolerance dose. The present installment of "Nuclear Notes" was prepared by R. H. Ritchie, of the Health Physics Division of the Oak Ridge National Laboratory, Oak Ridge, Tenn. This column appears monthly under supervision of the Sanitary Engineering Division's Committee on Sanitary Engineering Aspects of Nuclear Energy, of which Conrad P. Straub is chairman. The other members of the committee are Earnest F. Gloyna, A. E. Gorman, Prof. Warren J. Kaufman, Alexander Rihm, Jr., and James G. Terrill, Jr. The next installment continuing the subject of shielding will deal with the basic attenuation laws of photons in matter.

It has been established that a dose of X or γ radiation in the amount of 300 milliroentgens (thousandths of a roentgen, commonly abbreviated mr) per week, or 7.5 mr per hr (based on a 40-hr work week) may be sustained by man without apparent damage. The dose delivered by a given radiation field is a strong function of the energy of the photons in the field. Fig. 1 shows the dose rate D(E) in roentgens per hour delivered by a unit photon flux (one photon per cm² per sec) *vs.* the energy E of the photons (K. Z. Morgan, *Health Control and Nuclear Research*, Chapter 5, to be published). It is seen that above 100-kv energy the dose is nearly proportional to the energy.

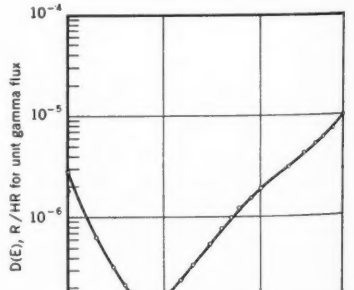


Fig. 1. Gamma Dose vs. Energy for Unit Incident Flux.

(Continued on page 92)

Nuclear Notes

(*Continued from page 86*)

It should be pointed out that the usual practice in determining permissible exposure to radiation is to assume that for doses in the maximum permissible range damage done by a given dose is independent of the period of time in which it is administered. Thus if a worker received 0.300 roentgen per hour (r per hour) in a given radiation field, he may stay in this field for only one hour per week, but he may work 40 hours per week in a field of 7.5 mr per hr.

The accompanying tabulation gives common radiation exposures to which man may be subjected. (K. Z. Morgan, *The Role of Engineering in Nuclear Engineering Development*," TID-5031, 1951. Obtainable from the Office of Technical Services, Dept. of Commerce, Washington 25, D. C.)

Type of Exposure	Dose
External exposure to naturally radioactive materials and to cosmic rays	.00007–.00011 r/day
Maximum permissible dose at U.S. AEC plants	.300 r/week
Chest X-ray (best conditions)	.040 r
Average chest X-ray	0.1–2 r
Dental X-rays	1.5–15 r
Fluoroscopic examinations	5–50 r
Fatal dose applied to entire body in a short period of time	200–800 r

References to the Literature

The following books contain much valuable information on shielding problems. The first two, in particular, contain information on neutron shielding which has not been previously available in the unclassified literature.

E. P. Blizard, "Nuclear Radiation Shielding," *Ann. Review of Nuclear Science* (1955). Annual Reviews, Inc., Stanford, Calif.

S. Glasstone, *Principles of Nuclear Reactor Engineering*, Van Nostrand (1955).

R. Stephenson, *Introduction to Nuclear Engineering*, McGraw-Hill (1954).

The following report, which is available from the Office of Technical Services, Dept. of Commerce, Washington 25, D. C., has a good bibliography of the unclassified literature on shielding:

C. J. Engberg, "Radiation Shields and Shielding," TID 3032 and supplement.

The writer has referred to the following reports a good deal in preparing this article:

H. M. Glen, *Introduction to Shielding for Engineers*, ORNL CF-51-10-221.

U. Fano, "Gamma-Ray Attenuation," *Nucleonics*, August 1953 and September 1953.

Mixing and handling techniques for concrete and aggregate materials are discussed in the following report:

T. Rockwell III, *Construction of Cheap Shields*, AECD-3352 which is obtainable from the Office of Technical Services.

ALL ACCIDENTS

FATAL ACCIDENTS

PROPERTY DAMAGE

ACCIDENTS DUE TO SKIDS

ACCIDENTS ON DRY ROADS

2 BILLION MILE ACCIDENT STUDY IN NORTH CAROLINA PROVES CONCRETE IS SAFER

An analysis of official 1953 North Carolina highway accident records shows conclusively that the type of pavement affects accidents. Covering more than two billion miles of travel and 6000 accidents on the state's heavily traveled roads, the study included 433 miles of concrete and 1152 miles of the other most commonly built pavement.

The results prove that concrete is far safer. *For equal vehicle miles* the other pavement accounted for:

24% more accidents
32% more fatal accidents
22% more property damage
67% more accidents due to skidding
18% more accidents on dry roads
46% more accidents on wet roads
23% more daytime accidents
29% more nighttime accidents

Safety is built into concrete with a gritty, highly skid-resistant surface. When wet it retains ¾, the other pavement only ½, of its dry coefficient of friction at 40 mph.

Concrete's light color reflects about 20%, dark pavement only about 5%, of headlight illumination. The tremendously significant difference in visibility is well known to drivers at night, when most accidents occur.

Highway users expect safe roads. Concrete pavement makes the safest roads. For more information write for free, illustrated literature. It is distributed only in U.S. and Canada.

Portland Cement Association
Dept. A12-13, 33 W. Grand Ave., Chicago 10, Ill.
A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

ACCIDENTS ON WET ROADS

DAYTIME ACCIDENTS

NIGHTTIME ACCIDENTS

DECEASED

Charles Smith Bradley (A.M. '41), age 43, assistant to the chief engineer and veteran employee since 1934 of Morrison-Knudsen Co., Inc., with headquarters in Boise, Idaho, died on October 1. A graduate of Rensselaer Polytechnic Institute, Mr. Bradley had a wide range of responsible assignments in the heavy construction field before transferring to the company's headquarters in 1952. At the time of Mr. Bradley's death he was president of the Southern Idaho Section of the Society.

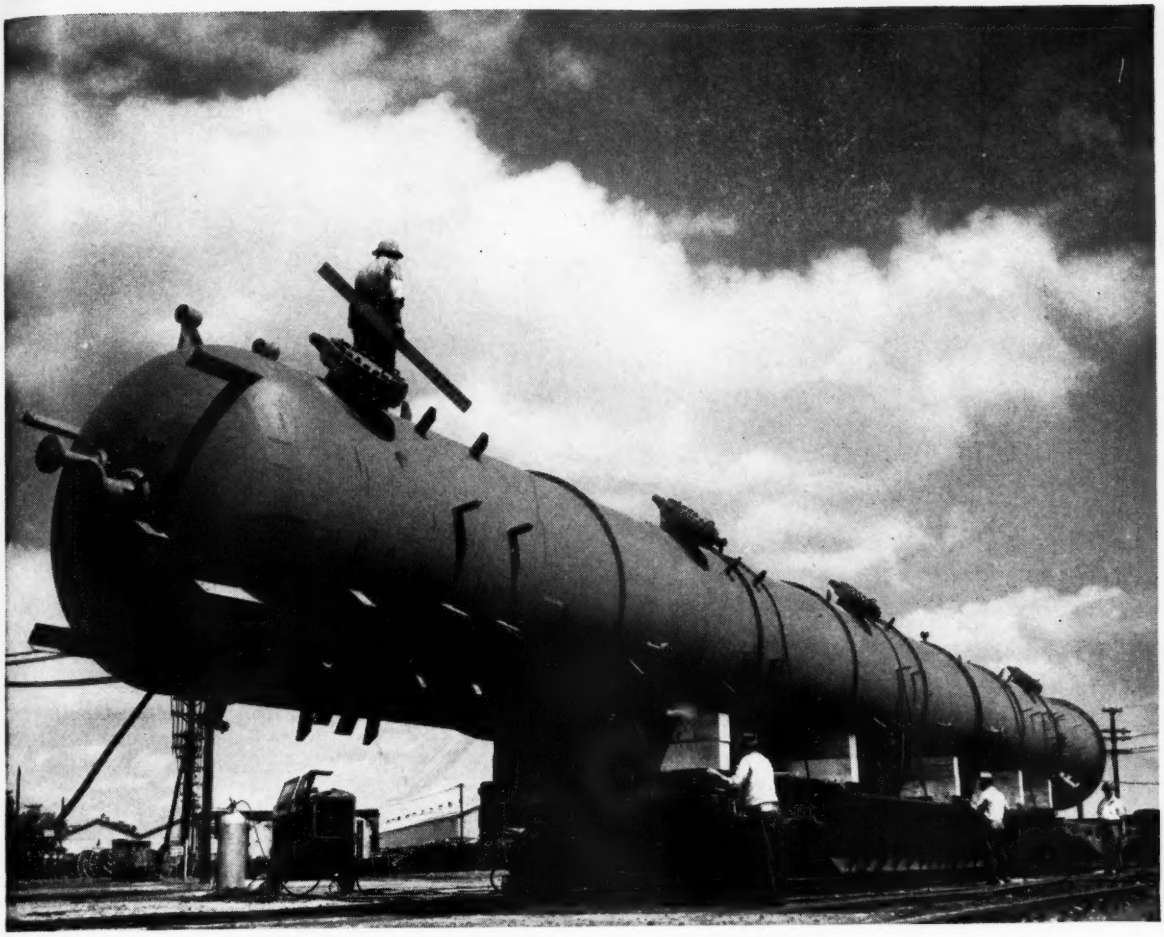
John Houston Clark (M.'45), age 75, civil engineer of Panguitch, Utah, died on May 1. A 1902 graduate of Gallaudet College, Mr. Clark began his career with the U.S. Forest Service. From 1913 to 1933 he served as field engineer for the State Road Commission of Utah. Mr. Clark was then in charge of various surveys for roads, highways, dams, possible oil-bearing structures, and water-works systems in Utah.

William Nicholas Dambach (M.'43), age 70, died at his home in Pittsburgh on May 5. Mr. Dambach served as a construction engineer on the Panama Canal, assistant superintendent of a building program for the Pittsburgh Board of Education, and as chief engineer for Hazel-Atlas Glass Co. In 1932 he organized the W. N. Dambach Corp., which he headed as president until his death. He was an alumnus of the University of Pennsylvania, class of 1905.

Robert George Dieck (M.'11), age 79, consulting engineer of Portland, Ore., died on July 6. A graduate of the University of Pennsylvania, class of 1896, Mr. Dieck went to the Philippines early in his career as provincial supervisor of the newly created Province of Rizal. In 1902 he was transferred to Manila to take charge of the Department of Water and Sewers, and from 1905 to 1907 he was city engineer of Manila. From 1907 to 1913 and from 1917 until his death Mr. Dieck had a consulting civil engineering practice in Portland. In the intervening four-year period he was Commissioner of Public Works for Portland in charge of a $35,000,000 construction program.

Arthur Engh (A.M.'16), age 70, of Chicago, Ill., died recently. Mr. Engh was associated with the Chicago, Burlington & Quincy Railroad Co., from 1915 through 1922, when he joined the Board of Local Improvements, City of Chicago, as senior engineer. Mr. Engh remained with the Board until his death, when he was engineer in charge of special improvements in the Department of Public Works.

(*Continued on page 98*)



The 110'6" debutanizer shown above and the 150-ton unit (below), a 3-stage axial flow compressor, are typical Newport News products. Whether you need a hydraulic turbine, vacuum tanks or penstocks . . . bridge caissons, digesters or dryer rolls . . . you can command the services of Newport News for units of about any size or shape.

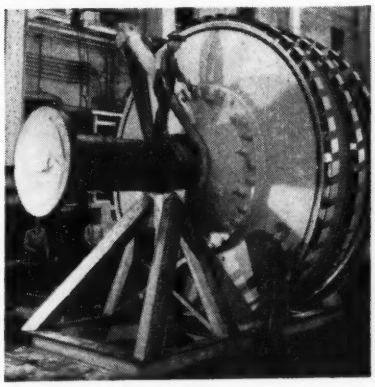
Newport News builds wide variety of large units

ALMOST ANY TYPE of heavy equipment can be built by Newport News.

And the reason? Specialized production techniques for one thing. You get the benefit of plant methods and equipment developed as a result of Newport News' seven decades of experience. Seven decades fabricating millions of tons of steel . . . carbon, corrosion-resistant alloy, clad and other special steels.

Moreover, Newport News' plant provides unsurpassed facilities. More than 225 acres in area, it comprises vast steel fabricating shops, five huge machine shops, acres of pattern shops and foundries. It includes forge and die shops, heat treating furnaces and allied equipment, along with complete modern test apparatus.

But most important of all . . . it is the high integration of skill and production facilities that enables Newport News to build large units fast . . . to save valuable time. Let us bid on your present or future projects. Write today for your copy of our illustrated booklet "Facilities and Products."



Engineers — Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

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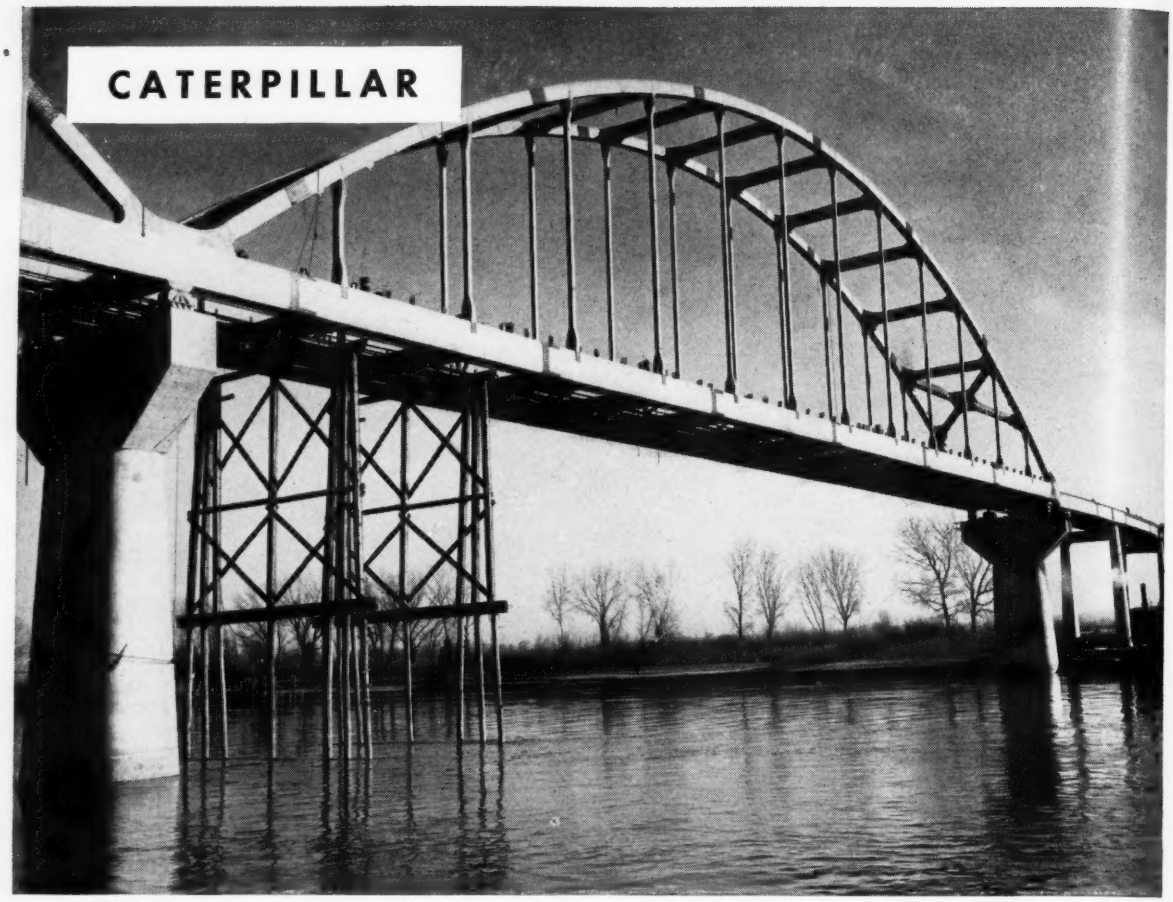
Newport News, Virginia



$4,000,000 MISSOURI RIVER BRIDGE at Leavenworth, Kansas, showing one of the two 420-foot tied-arch spans. It carries two lanes with an over-all width of 26 paved feet.

NEW BRIDGE TECHNIQUE COMES TO THE MIDWEST

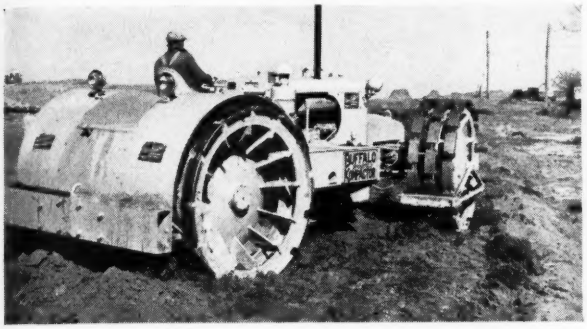
DW21 IS PUSH-LOADED BY D8 for Roberts Construction Co., which moved 960,000 yards of sandy earth for the east approach. Approximately 38 feet of fill were required at the approach end. No. 12 Motor Graders were used to maintain the haul road.

The recently completed Missouri River bridge at Leavenworth, Kansas, consisting of two 420-foot tied-arch spans with a 735-foot continuous girder approach on the east and an 860-foot continuous girder approach on the west, made use of two new techniques and one old standby.

New is the use of a heavy box girder bottom chord for the two arch spans which was continuous over the center pier and Vierendeel bracing. Traditional is the use of CATERPILLAR* equipment by all four contractors, helping them complete the bridge in 13½ months.

The use of the continuous bottom chord for the arch spans required the use of only one pair of shoes, rather than two, in the center pier, and permitted the use of a narrower pier. Vierendeel bracing replaced the conventional "X" type wind bracing. The use of these new techniques resulted in considerable savings.

D318 POWERS KOEHRING CRANE as it moves one-ton whalers for Maxwell Bridge Construction Co. Crane was used for setting forms, pouring concrete, driving pile, erecting and laying steel.



A CAT D318 DIESEL powers this new Buffalo-Springfield Kompactor, the first such unit used in the Kansas City area. Here it is used by J. A. Tobin Construction Co., which graded and seeded the west approach and paved six miles of east approach.

MANITOWOC CRANE POWERED BY D17000 unloads I-beams and sets them in place for Kansas City Bridge Co. By itself, it handled beams up to 95 feet long and weighing 20½ tons. A D13000 powered the Gardner-Denver compressor, at left, which furnished power for two riveting guns and rivet heater.

Novel use of tied-arch spans and bracing on bridge at Leavenworth

But there was nothing new about the use of Caterpillar equipment on the job. Kansas City Bridge Co. built the approach viaduct on the east side of the Missouri, which consisted of six bents and one abutment, supporting the continuous girder spans. Caterpillar yellow was the predominant color of the equipment, like the powerful D17000 Diesel Engine which powered a Manitowoc crane for unloading I-beams and setting them in place.

Drawing on more than 30 years in the business, R. D. Bleich, general superintendent for Kansas City Bridge Co., said, *"We know CAT* equipment will always stay in there and do the job."*

Grading, drainage and seeding on the east approach roads was done by Roberts Construction Co., Lincoln, Nebr., which moved 960,000 yards of sandy earth, as a subcontractor for Olson Construction Co. of Lincoln. Cat equipment on the job included four DW21s, three No. 12 Motor Graders and eight D8s, one D7, two D4s and two No. 80 Scrapers. Equipment worked 18 hours a day, six days a week and brought this comment from operator Charles E. Jones:

"Caterpillar makes the best earth-movers going, and I've run everything made."

Maxwell Bridge Construction Co., Columbus, Kansas, built 900 feet of the west approach, including eight bents and the concrete floor. Its workhorse was a Koehring crane powered by a trouble-free Cat D318 Diesel.

"When you get to heavy work, you can't beat a Caterpillar Diesel," reported L. D. Paul, superintendent.

Grading and seeding on the west approach, and six miles of paving on the east approach, was done by J. A. Tobin Construction Co., Kansas City, Kansas. Again big yellow equipment was on the job.

"Cat-built machines are all we use," said a foreman. *"We couldn't get along without them. They stand up and do more work."*

Like construction men everywhere, the four contractors who built the unique Leavenworth span are in complete agreement in their approval of Caterpillar equipment.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS, U. S. A.

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Deceased

(*Continued from page 94*)

Robert Arnold Foster (M.'11), age 78, since 1918 president of the Mexican Coal and Coke Co., Las Esperanzas, Mexico, died March 9. An 1898 graduate of the University of California, Mr. Foster had been president of the Alaska-Peninsular Coal and Coke Co. and of the Lewiston-Clarkston Improvement Co., Clarkston, Wash.

Malcolm Gilchrist Hibbert (M.'49), age 63, utility engineer for the J. E. Greiner Co., Cleveland, Ohio, died on August 1. A native of England, Mr. Hibbert was a graduate of the University of Virginia. He had been city engineer of Charlottesville, Va.; chief engineer of the Coronet Phosphate Co., Plant City, Fla.; resident engineer of the Bonnet Carré Spillway levee construction; and planning and designing engineer for the U.S. Engineer Office at Galveston, Tex. Since January 1950 he had been with J. E. Greiner performing assignments in Houston and Corpus Christi, Tex., and on the Ohio Turnpike Project, with headquarters at Cleveland.

Wilfred Main Honour (M.'49), age 47, associate professor of civil engineering at Tennessee Polytechnic Institute, Cookeville, Tenn., died suddenly on September 7. A 1929 graduate of the Georgia School of Technology, Mr. Honour had been a resident engineer with Roberts and Co. and with the Georgia State Highway Department. Since 1941 he had taught at Georgia Institute of Technology, Alabama Polytechnic Institute, the University of Texas, and Tennessee Polytechnic Institute.

Richard Oscar Green (M.'27), age 68, district engineer for the U.S. Bureau of Reclamation at McCook, Nebr., died there on October 10. A 1911 graduate of the University of Nebraska, Mr. Green was a pioneer member of the Nebraska State Highway Department, which he served as project engineer and division engineer. From 1935 to 1947 he was assistant chief engineer and general manager of the Central Nebraska Public Power and Irrigation District. With the Bureau of Reclamation from 1947 on, he had been district engineer for the Republican River District and the Kansas River District. Vice-president of the Nebraska Section at the time of his death, Mr. Green was largely responsible for the recent formation of the Section's Southwest Branch.

Richard O. Green

Philip Bracken Fleming (M.'44), retired Major General, U.S. Army, died in Washington, D. C., on October 6, a few days before his 68th birthday. A 1911 graduate of the U.S. Military Academy at West Point, General Fleming spent his career in the U.S. Army. He had been in charge of the Finance Division, Office of the Chief of Engineers; on the teaching staff at West Point; executive officer and deputy administrator of the PWA in Washington; engineer in charge of the controversial Passamaquoddy tidal power project; and district engineer for the U.S. Engineer Department at St. Paul. More recently General Fleming had been director of the Wage and Hour Division of the Department of Labor; administrator of the Federal Works Agency; chairman of the U.S. Maritime Commission; and U.S. Ambassador to Costa Rica.

General Fleming

George Samuel Lane (A.M. '24), age 66, of Los Angeles, Calif., died recently. A native of London, England, Mr. Lane had been employed by the Union Oil Co. of California since 1919. At the time of his death he was chief surveyor for the company.

(*Continued on page 100*)

Deceased

(*Continued from page 98*)

Former Director Jacob Langthorn Is Dead

Jacob Stinman Langthorn (M.'05), age 88, retired consulting engineer to the President of the Borough of Manhattan and former Director of ASCE, died October 23 at his home in Mount Dora, Fla. A graduate of Columbia University, Mr. Langthorn entered the service of the City of New York as a development engineer with the Board of Water Supply. Next he was appointed deputy commissioner of the Department of Water Supply assigned to Brooklyn. For some years Mr. Langthorn was president of the firm of Langthorn & Smith, engineering contractors. Among the achievements of which he was especially proud was the planning of the underground magazines for dynamite used on the Catskill tunnels for New York water supply. He was ASCE Director from 1919 to 1921.

Ferdinand Joseph Litter (M.'15), age 79, consulting engineer to the Frederick Snare Corp., New York, died on October 6. An 1895 graduate of the College of the City of New York, Mr. Litter served with the First U.S. Volunteer Engineers in the Spanish American War. After three years with the Pennsylvania Steel Co., he joined the Frederick Snare Corp., with which he was connected for the rest of his life.

Alfred Ragner Matthews (A.M.'48), age 51, commanding officer of Camp Kilmer, N.J., died at his home in New Brunswick, N.J., on October 31. Colonel Matthews had been in the army for 20 years. Before entering the Corps of Engineers, he was employed by the state of New Jersey as a civil engineer.

Alexis McCormick, (A.M.'31), age 70, of Houston, Tex., died June 11. A 1904 graduate of the Agricultural and Mechanical College of Texas, Mr. McCormick started his career in railroad work and as an engineer with several Texas construction companies. He had been county engineer for Madison County, Texas, city engineer for Madisonville, Tex., and engineer and division engineer for the Texas Highway Department on many assignments. Mr. McCormick had also been engineer for Conroe and Corpus Christi, Tex. In 1946, with C. F. Teller, he formed a consulting engineering partnership which continued during the remainder of his career.

John James O'Hara (J. M. '51), age 30, of Yonkers, N.Y., died on October 23. Mr. O'Hara was a draftsman with Gibbs & Hill, Inc., New York. He was a graduate of Manhattan College, class of 1951.

(*Continued on page 102*)

Deceased

(*Continued from page 100*)

Charles Edward Parsons (M.'12), age 82, of Princeton, N.J., died September 26. An 1898 graduate of Union College, Mr. Parsons had been chief engineer for the Hudson River Electric Power Co., Albany, N.Y., the Atlanta Power Co., Atlanta, Ga., and the Deppe Motors Corp. New York, N.Y. He had also been with Ross & Playfair of Montreal doing research at the Department of Mines, Ottawa, an engineer with the John B. Pierce Foundation, New York, and office engineer for F. H. McGraw & Co., New York. He had had consulting practices in New York and Princeton and was a captain in the Corps of Engineers in World War I.

Raymond Gilbert Pitz (J.M.'52), age 26 of Oshkosh, Wis., died on September 19. A 1952 graduate of the University of Wisconsin, Mr. Pitz was an engineer with the Wisconsin State Highway Commission.

Charles Willett Spooner (M. '21), age 75, retired engineer of Leland Mich., died on September 25. A specialist in public utility work, Mr. Spooner had a private practice in Chicago for many years—from 1927 until his retirement as president of Spooner & Merrill, Inc. He was a 1906 graduate of the University of Michigan.

Lewis Delmar Suhr (M.'40), age 61, president of Suhr, Berryman, Peterson & Suhr, Chicago, and a resident of Evanston, Ill., died on June 17. Associated with the company bearing his name since 1921, Mr. Suhr designed and supervised the construction of many important Midwestern projects. He was a 1917 graduate of the University of Wisconsin, and served in World War I with the rank of captain.

Richard Randolph Tipton (M.'49), age 60, consulting engineer of Berkeley, Calif., died there suddenly on October 4. Mr. Tipton had just opened his consulting office in Berkeley after retiring from the U.S. Bureau of Public Roads. For the past eleven of his thirty years in the Bureau, he had been division bridge engineer at Kansas City in charge of all bridge work in a seven-state area. He was an alumnus of the University of Washington, Seattle, and a veteran of World War I. Active in the Kansas City Section, he was president in 1954.

Melvin Delano Williams (M.'26), age 79, retired civil engineer, died at Richmond Beach, Wash., on September 28. An 1898 graduate of Colorado Agricultural College, Mr. Williams conducted a topographic survey of the Colorado River and Grand Canyon for the U.S. Reclamation service (now the Bureau of Reclamation) before transferring to the Bureau of Public Roads in 1919. After six years in charge of forest highways in Utah, he became the first public roads administrator in Alaska, continuing in that position until his retirement in 1945.

Recent Books

(*Continued from page 29*)

Handbook of Engineering Materials

Designed to meet the need of engineers for a convenient single source of data on the usual materials of manufacturing and construction, this handbook gives essential information concisely and suggests sources of more complete information. Materials are classified under three broad groups—metals, non-metals, and construction materials. Information is given on grades, properties, applications, sources of supply, and, where pertinent, design, fabricating, and other data. There is also general information on specifications, standards, constants. Edited by Donald F. Miner and John B. Seastone (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, 1955. Varied paging, $17.50.)

Stauanlagen und Wasserkraftwerke

Part III: Wasserkraftwerke

The design, construction, and operation of hydroelectric power plants are dealt with in this third volume of a series by Heinrich Press on dams and power plants. It covers structural details, turbines, and auxiliary installations—both high and low head, and methods of calculation of water hammer, head losses, etc. Underground and submerged plants are included. (Wilhelm Ernst und Sohn, Berlin, 1954. 340 pp., DM 35.00.)

ASTM Standards in Building Codes

More than 250 specifications, methods of test, and definitions of materials referred to in building codes of the United States and Canada have been brought together in this compilation of the American Society for Testing Materials. The standards cover the full range of construction materials including structural and reinforcing steel; steel, cast-iron, and copper pipe; bituminous roofing; ready-mixed concrete; and many others. (American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1955. 950 pp., $6.00.)

Forages et Sondages

Leur Emploi dans les Travaux Publics

Over half of this book on drilling and boring operations is concerned with the equipment and methods for rock drilling: types of drills, headgear, casings, theory and practical procedures, drilling mud, etc., with some treatment of the geometrical characteristics of boreholes. Part II covers the taking of core samples and borehole logging. Part III discusses the use and value of drilling procedures in civil engineering operations, particularly with respect to foundations. The author is H. Cambefort. (Editions Eyrolles, Paris, 1955. 396 pp., 3,200 Fr.)

Symposium on Concrete Shell Roof Construction, Proceedings

The papers contributed to this symposium by engineers, mathematicians, architects, and representatives of the construction industry are edited by P. J. Witt and are grouped in three broad divisions: architectural aspects; design and research; and construction and framework. Among the specific topics considered are methods of analysis, theory of new forms of shell, combination of shells and prestressing, and design and construction from the economic aspect. A comprehensive bibliography is included. (Cement and Concrete Association, London, 1954. 258 pp., 30s.)

Der Stahlbetonbau

Volume 2

This second volume of a manual by Carl Kersten and revised by Heinrich Kuhnert on reinforced concrete theory and practice deals with applications in office building construction and in engineering and industrial structures. Design details are given for floors, columns, roofs, precast elements, foundations, tanks, sports structures, and a considerable variety of special construction types. (Wilhelm Ernst und Sohn, Berlin, 18th Edit., 1954. 255 pp., DM. 16.00.)

Bibliographic Survey of Corrosion, 1950-1951.

This compilation of 4454 abstracts by the National Association of Corrosion Engineers is the fourth in a series covering 1945–1951. As in previous volumes, the abstracts are arranged by specific subdivisions under the eight main groups of the NACE filing system: general, testing, corrosion phenomena, corrosive environments, preventive measures, materials of construction, equipment, and industries. An author index and a detailed subject index complete the volume. (National Association of Corrosion Engineers, 1061 M & M Building, Houston 2, Tex., 1955. 435 pp., $12.50—members $10 00.)

Bibliography on Prestressed Concrete

This bibliography, prepared by a combined ACI-ASCE committee, contains over 1600 references from 1896 to 1953, arranged chronologically with an alphabetical arrangement by author within each separate year. The whole range of activity in the field, both theoretical and practical, is covered, and publications from all over the world have been included. There is a separate listing of patents. (American Concrete Institute, 18263 W. McNichols Road, Detroit 19, Mich., 1954. 83 pp., $2.00.)

Elementary Plane Surveying

For the new edition of this standard text, the entire book has been critically reviewed. Many sections have been rewritten, and new material has been included on mine surveying, mineral-

(*Continued on page 108*)

Recent Books

(*Continued from page 106*)

land surveying, photogrammetry in route location, new types of instruments, setting a monument, and aircraft jigs. Raymond E. Davis is the author. (McGraw Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., third edition, 1955. 507 pp., $5.50.)

Elements of Hydraulic Engineering

The subject matter is presented in three broad divisions covering general hydrologic and legal considerations; structures and their appurtenances; and pertinent elements of engineering economy. Intended for an introductory course, the book stresses fundamentals and includes only a minimum of detail on physical construction. Ray K. Linsley, Jr. and Joseph B. Franzini are the authors. (McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1955. 582 pp., $9.00.)

Elements of Soil Conservation

A brief presentation by Hugh Hammond Bennett of the more important aspects of the problems of soil and water wastage and methods of conservation. Specific topics dealt with include extent, effect, processes, and rates of erosion, rainfall penetration, contouring, gully control, farm irrigation, upstream flood control, and others (McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., second edition, 1955. 358 pp., $3.96.)

Grundbau-Taschenbuch

Volume I of this comprehensive handbook on foundation engineering covers the theoretical principles of soil mechanics, earth pressure calculations, behavior of foundation soil under load, building materials, and the design and construction of different types of foundations. Volume II presents the most important German codes and regulations for foundation work and includes a list of codes of other countries. H. Schröder is the editor. (Wilhelm Ernst und Sohn Verlag, Berlin, 1955. 847 pp.,—Vol. I DM 63.00, Vol. II DM 22.00.)

Materials for Nuclear Power Reactors

Another in a series of concise summaries of essential information on new developments in various fields of science and technology. The present volume, by Henry H. Hausner and Stanley B. Roboff, deals with criteria for selecting materials for shielding, for cladding of fuel elements, for moderators and reflectors, and for most of the important parts of a reactor. The material is presented in a form understandable to the layman with some technical background. (Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y., 1955. 224 pp., $3.50.)

Hawley's Technical Speller

This book—compiled by Gessner G. and Alice W. Hawley—contains over 8,000 technical words selected from the vocabularies of chemistry, physics, electronics, biology, medicine, engineering, and other fields of science and technology. Recommended word divisions are indicated. A separate list gives the correct prepositions for use after certain words. (Reinhold Publishing Corp., 430 Park Ave., New York 22, 1955. 146 pp., $2.95.)

Hölzerne Brücken

This standard German manual on wooden bridges (eighth edition) covers the design and calculation of bridge members, construction of the roadway, and the design and construction of the supporting framework, abutments, piers, piles, etc. An introductory section reviews the properties of timber. Authors are August Laskus and Hans Schröder. (William Ernst und Sohn Verlag, Berlin, 1955. 259 pp., DM 43.)

Bewegungsfugen im Beton-und Stahlbetonbau

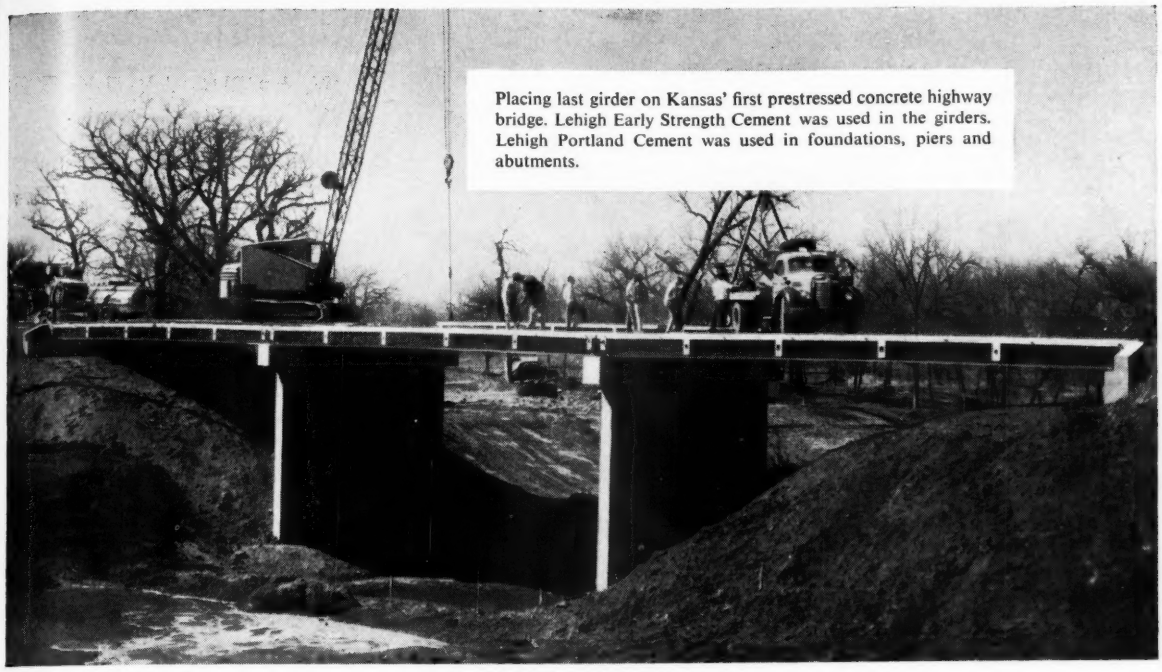
Dealing with expansion joints in concrete and steel construction, this book by Adolf Kleinlogel discusses the importance of such joints, and gives more than 300 examples of the design and construction of buildings and other structures incorporating them, including silos, tanks, swimming pools, harbor works, bridges, pipelines, roads, tunnel and mine structures, etc. (Wilhelm Ernst und Sohn, Berlin, 5th edit., 1954. 271 pp., DM 24.00.)

Plastics for Corrosion-Resistant Applications

The aim of this book—by Raymond B. Seymour and Robert H. Steiner—is to provide reliable information which will permit the proper application of plastic materials in corrosive atmospheres. The various plastics and resins are discussed in the form in which they are applied—coatings, linings, impregnants, adhesives, pipes, etc.—and information is given on the comparative chemical resistance of these materials. A separate section provides a guide to the selection of plastics for specific corrosion problems. (Reinhold Publishing Corp., 430 Park Ave., New York 22, 1955. 423 pp., $7.50.)

Durchbiegungs-Ordinates Für Einfeld- und Durchlaufende Träger

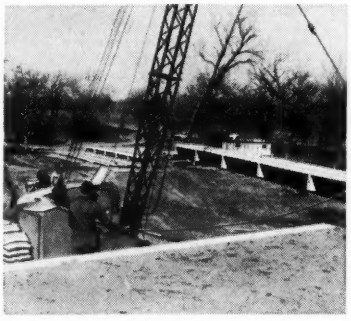
A text and reference book by Georg Anger and Karl Tramm for the structural designer, giving tables of deflection ordinates for single-span and multiple-span beams. The tabulated data are for 10-point influence lines for cases having up to five supports with varying span-widths. An explanatory section gives basic formulas and detailed design information. (Werner-Verlag, Düsseldorf, 1953. 193 pp., DM 25.00.)



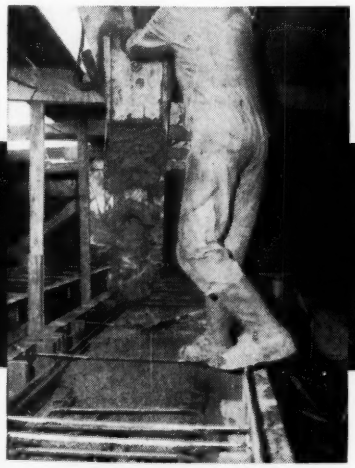
Placing last girder on Kansas' first prestressed concrete highway bridge. Lehigh Early Strength Cement was used in the girders. Lehigh Portland Cement was used in foundations, piers and abutments.

Owner—LINCOLN COUNTY, Kansas
General Contractor—ANDERSON CONSTRUCTION CO., Holton, Kansas
Prestressed girders designed by—KANSAS CITY PRESTRESSING, INC., Kansas City, Missouri

• One of the 30 prestressed beams being swung into position. Note casting bed in the background. Each beam is 45′ long and 1′ 10″ deep. Width at top is 31¼″, at bottom 10″. Web is 5″ thick.



• Pouring girders at job site casting bed. Tarps cover bed to contain heat from salamanders and protect concrete from *temperatures that averaged* 10° *above zero.*



75 days saved . . .

with LEHIGH EARLY STRENGTH CEMENT

The first prestressed concrete highway bridge in Kansas was built last winter, replacing a worn-out structure near Lincoln. To reopen the road as quickly as possible and to keep the high cost of cold weather construction at a minimum, Lehigh Early Strength Cement was used in the prestressed deck girders.

The results! Girders reached post-tensioning strength in ¼ the usual time. Form costs were cut 50%, winter curing costs 30%. The *75 calendar days saved* in casting the girders greatly reduced labor and overhead costs—and permitted earlier reopening of the road.

Try Lehigh Early Strength Cement on your next winter job. It will help you speed operations, cut costs.

LEHIGH EARLY STRENGTH CEMENT
LEHIGH PORTLAND CEMENT
LEHIGH AIR-ENTRAINING CEMENTS
LEHIGH MORTAR CEMENT

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PORTLAND CEMENT CO.

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Positions Announced

United States Civil Commission. Applications for competitive examinations for Highway Engineer Trainee positions for duty in the Bureau of Public Roads, may be obtained from any post office and from the U.S. Civil Service Commission, Washington 25, D.C. Application cards must be received or postmarked before January 25, 1956. Salary range for the positions is from $3,415 to $4,345.

Corps of Engineers. The New York District of the Corps of Engineers has a critical need for engineers for work on military and civil construction projects. Positions include: Civil Engineers (Sanitary GS-11), $6,390; Structural Engineers (GS-9-11), $5,440 to $6,390; Hydraulic Engineers (Design GS-9-11), $5,440 to $6,390; Materials Engineers (Soils, Asphalt Concrete GS-7, 9, 12), $4,390, $5,440, $6,390, $7,570; Construction Engineers, (GS-7-9), $4390 to $5,440. Information from the Personnel Branch, New York District, U. S. Corps of Engineers, 11 East 16th St., New York 3, N. Y. (Spring 7-4200, extensions 349 or 350).

U. S. Soil Conservation Service. The SCS in Mississippi needs civil, agricultural and hydraulic engineers. Starting salaries are $4,345, $4,930, and $5,440, depending on experience. If interested, please write Soil Conservation Service, PO Box 610, Jackson, Miss., giving a brief summary of educational background and experience.

California State Personnel Board. Vacancies now exist for engineers at Los Angeles and Indio in the south and at Santa Rosa and Bishop in the central part of the state as a result of the statewide program of water pollution control. The recruitment section of the State Personnel Board, 801 Capitol Ave., Sacramento, is looking for water pollution control engineers at both the associate and senior level. Interested persons must be prepared to go to California for the interview and examination

U.S. Civil Service Commission. Positions in the Bureau of Reclamation located throughout the western states and Alaska, with entrance salaries starting at $4,345 to $5,440 a year. There will be no written test but appropriate engineering experience is necessary. Further information and application forms may be obtained at post offices throughout the country or from the U. S. Civil Service Commission, Washington 25, D.C., or from the Central Board of U.S. Civil Service Examiners Bureau of Reclamation, Denver Federal Center, Denver, Colo., until further notice.

Corps of Engineers. The Engineer Center at Fort Belvoir, Va., has the following positions available: Bridge Engineer GS-7-9-11, $4390-$6390p/a; Civil Engineer GS-5-7-9-11, $4345-$6,390p/a; structural engineers, GS-9, $5,440p/a. Secure applications from Federal Employment, Standard Form 57, or any Civil Service or Department of the Army Civilian Personnel Office. Mail them to Civilian Personnel Office Employment Division, Room 200A, Bldg. 211, 21st St., The Engineer Center, U. S. Army, Fort Belvoir, Va.

City of St. Louis. The city of St. Louis, Mo., has the positions of civil engineer I ($369.31 to 423.91 per mo.), Civil Engineer II, ($419.58 to $486.31), and Civil Engineer III, ($527.04 to $595.51), available. Write to the Department of Personnel, 235 Municipal Courts Building, St. Louis, Mo.

City of Norwalk. The city of Norwalk, Conn., has the following vacancies on their staff: assistant city planner ($4,050 to $4,850), and city planner ($4,450 to $5,450). For further information write to the city Planning Commission, Veterans Memorial Park, Norwalk, Conn.

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

CIVIL ENGINEER; J.M. ASCE; C.E., 1954; Engineering in Training, Ohio; 26; married. Desires municipal, county, or field engineering in New York State or New England. Experience: commercial and industrial building construction (3 years cooperative); highway and bridge design and construction, soils analysis (1 year full-time employment.) C-90.

SUPERINTENDENT OF CONSTRUCTION, MUNICIPAL WATER WORKS, OR CITY ENGINEER; A.M. ASCE; location desired, Oklahoma, Texas, the South, or overseas in temperate climate. Over 40 years in responsible capacities in airfield design and construction, municipal water and sewage works, design construction and operation; dam construction; railroad location, construction, operation; and defense construction. C-91-356-Chicago.

CIVIL ENGINEER; J.M. ASCE; 25; married; B.S.C.E., 1951; 2½ years' experience in concrete design and construction in field and office. Just completed 2 years in heavy construction with U.S. Army Corps of Engineers. Desires position with general contractor. Available January 1956. Location preferred, central or southern California. C-92-1029-San Francisco.

CIVIL ENGINEER; J.M. ASCE; 30; married; B.S.C.E.; 5 years' experience as field engineer; land surveys; steam plant and paper mill construction. C-93.

JUNIOR CIVIL ENGINEER; J.M. ASCE; 26; married; B.C.E., 1953; 2½ years' responsible experience in Department of Public Works, City of New York. Available late November, upon release from Corp of Engineers, U.S. Army. Desires responsible position in either structural or highway design, with opportunity to advance. C-94.

SENIOR ADMINISTRATIVE CIVIL ENGINEER; A.M. ASCE; with 25 years' wide experience in construction, maintenance, production phases of large operations; major industrial emphasis cost control. Field practice from design survey through resident engineer on heavy excavation, plant, buildings, services, townsites. Office functions include structural design; economic studies; liaison, office, cost project engineer; drafting administration contracts. C-95

CIVIL ENGINEER; J.M. ASCE; B.S.C.E, 1950; P.E., New Jersey; 29; married; experienced in estimating and construction of buildings, piling, pipelines, bridges, and general engineering type construction. Desires position in New Jersey. C-96.

CONSTRUCTION EXECUTIVE; M. ASCE; B.S.-S.E.; 1940; graduate work; registered professional engineer; 37; married; over 17 years' diversified experience as engineer, designer, general superintendent, and executive in general construction (heavy). Over 6 years' active duty in Line and Civil Engineer Corps, U. S. Navy. Desires administration or executive position. Prefer opportunity to become member of firm. C-97.

Positions Available

ASSISTANT CITY ENGINEER, civil, under 50, P.E., with experience in construction and design. Civil Service tenure. Salary, $7,740–$8,688 a year. Location, Michigan. W-2102-D.

ESTIMATOR, civil graduate, with field engineering and estimating experience on bridges, foundations and general heavy construction. Salary, $6,000–$8,500 a year. Location, western Pennsylvania. W-2108.

ENGINEERS: (*a*) Construction Managers, experienced, to take charge and handle the construction of a large paper mill. Must have extensive experience in the construction of major and modern paper mill. (*b*) Project Managers, experienced on the construction of steam-electric generating plants. Location, South. W-2142.

ENGINEERS: (*a*) Project Engineer, Structural, B.S. in Civil or Architecture, 30–45, at least 5 years of heavy construction supervision or administration. Will supervise personnel of construction contractors and prepare reports, etc. (*c*) Office Engineer, 30–45, B.S. in civil or mechanical engineering; at least 8 years' experience in heavy construction or engineering. Estimate all phases of work—structural, mechanical, electrical, utilities, etc. Prepare all construction project estimates, prepare and execute all construction change orders, etc. Salaries open. Location, New York State. W-2162.

SALES ENGINEER, 27–35, civil graduate, with concrete experience, for technical field work with customers of cement manufacturer. Salary, $4,800–$6,000 a year. Location, Northeast. W-2165.

SAFETY ENGINEER, degree, for casualty insurance field. Will consider a recent graduate, but prefer man with some experience. Will represent company to clients in a consulting capacity on safety measures to prevent losses. Clients include many large industrial organizations. Salary open. Considerable traveling. Location, after training period, West Coast. W-2175-S.

TOWN ENGINEER, civil graduate, with at least 5 years' public works engineering experience covering municipal buildings, streets, sanitary and water facilities. Salary, $7,500–$8,500 a year. Location, Nassau County, L.I., N.Y. W-2204.

CONSTRUCTION ENGINEER, with civil or mining engineering training and tunnel experience, to supervise line and grade, check quantities and do project engineering. Salary, $8,400 a year minimum. Location, western Pennsylvania. W-2220-Rewritten.

CONSTRUCTION SUPERINTENDENT, civil engineer, with experience in the construction of commercial and industrial building in southern Ohio. Opportunity for advancement. Salary open. W-2257-D.

SURVEYOR-ENGINEER, not over 35, preferably married, experienced as chief of party or instrumentman. Capable of keeping good field notes, fair draftsman. Must be graduate or have sufficient experience in surveying and general civil engineering, to carry out instructions in field and office on land surveys, minor design problems on highways, drainage and small structures. Draft exempt. Salary open. Location, Florida. W-2268.

HIGHWAY ENGINEER, registered civil engineer, specialist in highway and turnpike design. Will head a newly formed highway engineering subsidiary of a well-established Eastern engineering and construction firm. Salary open. W-2297.

AIRPORT MASTER PLANNER for Eastern architect-engineering firm. Registered architect or civil engineer with extensive experience in master planning of complete airports. Salary open. W-2302.

CONSTRUCTION ENGINEER, young, civil graduate, with estimating, office engineering and building construction experience covering schools, commercial and industrial buildings. Salary open. Location, South Carolina. W-2308(*b*).

PROJECT MANAGER for new major work in architecture, mechanical or civil engineering and 10 to 15 years' experience in engineering construction or maintenance work with at least 5 years in a supervisory capacity. Will supervise the work and follow-up on major projects to be carried out by the private contractors. May assist in the designing of buildings, utilities, or other types of construction, alterations or maintenance projects. Salary, $6,000–$7,500 a year. Location, Upstate, New York. W-2331.

ASSISTANT OFFICE AND FIELD ENGINEER, Young, civil graduate, with construction experience for study and design of plant improvements at crushed stone producer. Salary, $5,000–$6,000 a year. Location, eastern New York State. W-2364.

DIRECTOR OF ENGINEERING, civil graduate, with structural experience and 8 to 10 years' administrative experience in supervising complete engineering department for large architectural and engineering firm. Duties will include direction and coordination of structural, civil, mechanical, and electrical engineering departments. Location, California. W-2356-S.

DEVELOPMENT ENGINEER, 30–39, B.S. in Civil, Mechanical, or Architectural Engineering, with 3 to 5 years' experience in architecture or mechanical engineering. Will have outside contact with major architectural firms, contractors and fabricators. Will do development work in architectural field. Salary open. Location, California. W-2392.

ENGINEERS: (*a*) Resident Engineer with at least 10 years' highway and bridge construction experience; (*b*) Field Engineer with at least 5 years' highway and bridge construction experience; (*c*) Transitman with construction experience, to give line and grade; (*d*) Inspectors with highway or heavy construction experience. Salaries open. Location southern Connecticut. W-2423.

To the Executive Secretary of ASCE
33 West 39th Street, New York 18, N.Y.

- ☐ I wish to take part in the work of the Pipeline Committee.
- ☐ I volunteer as a worker on the following sub-committee:

  .....
- ☐ I volunteer as a speaker on the following subject:

  .....
- ☐ I suggest the following as a speaker and subject:

  .....
- ☐ Attached are my suggestions for future programs, speakers, other activities, possible new members, or informative data for your files.
- ☐ I am in favor of a new Pipeline Division.
- ☐ If a new Pipeline Division is formed, please enroll me.
- ☐ I am now enrolled in the..... Division.

Signed:.....Grade:.....

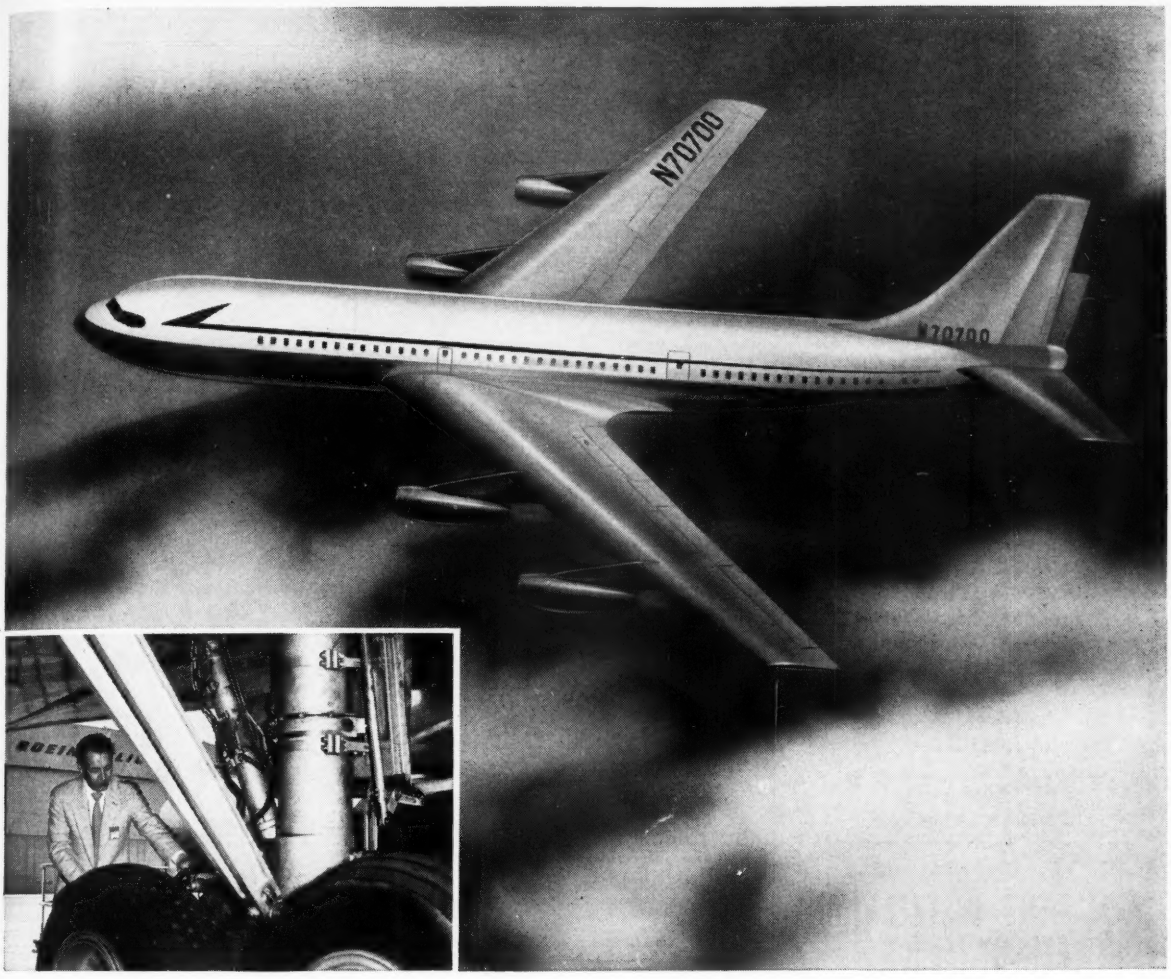
Address:.....

.....

Company:.....

Title:.....

Nature of position:.....



Boeing "C.E.'s" help create America's first jet transport

Here is another important "first" for Boeing civil engineers. They played an important part in creating the Boeing Jet Stratoliner 707, shown here as it will look when it takes to the air. Many Boeing civil engineers are now at work perfecting this epochal airliner. Other civil engineers are developing structures and components for years-ahead airplanes and guided missiles that will continue to enhance Boeing leadership—and their own professional prestige.

A prototype of the 707 has been flight-tested for well over a year, both as a commercial jet transport and as the KC-135 jet tanker for the Air Force. Boeing engineers are proud of their vital contributions to this and other aircraft: the Boeing IM-99 Bomarc pilotless interceptor, now under intensive development . . . the giant B-52 global bomber, at present being delivered to units of the Air Force . . . the B-47 jet bomber, mainstay of Strategic Air Command. These engineers are members of aviation's top creative team. There are more than twice as many of them with Boeing now than at the peak of World War II. This is evidence of the company's solid expansion, and of the opportunities for engineers' career growth.

The importance of the civil engineer's art is continually increasing at Boeing: in structural development that utilizes new materials like titanium, magnesium, special alloys and plastics; in flight and static testing; in stress analysis, and many other large and fast-growing fields.

Boeing needs additional engineers, mathematicians and applied physicists with advanced degrees now. If you feel that *you* would fit in with Boeing's tradition of engineering leadership, there may be a place for you on a team in research, design or production.

JOHN C. SANDERS, Staff Engineer—Personnel
Boeing Airplane Co., Dept. D-46, Seattle 14, Wash.

R. J. B. HOFFMAN, Administrative Engineer
Boeing Airplane Co., Dept. D-46, Wichita, Kansas

If you want further information on the advantages of a career with Boeing, please send coupon to either of the above addresses.

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College(s) _____ Degree(s) _____ Year(s) ____

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City _____ Zone ____ State _____

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Applications for Admission to ASCE, Oct. 15–Nov. 12, 1955

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FRANK ANTHONY BUTRICO, Washington, D.C.
ARTHUR CHENG CHUNG CHANG, Taiwan, Formosa
TSUNG-LIEN CHOU, Newark, N. J.
ROBERT CHARLES DEHART, Washington, D.C.
RICHARD NEIL DOOLITTLE, Sacramento, Calif.
JOHN BARNETT DUNBAR, Montgomery, Ala.
PETER FERRER, Richmond, Va.
AMERIGO GINNINI, Hammond, Ind.
M. TED JACOBS, Santa Ana, Calif.
HAL JUDSON JENNINGS, Denver, Colo.
GALE ORLA KENYON, Barstow, Calif.
MARVIN CLARK MAY, Albuquerque, N. Mex.
HUGH HAYNSWORTH MCCALLUM, Guatemala City, Guatemala
KENNETH EDWARD EVERY MILLER, Eldoret, Kenya
IVAN ALLEN MOORE, Denville, Ill.
MIGUEL ANGEL RIVERA BERMUDEZ, Honduras, C.A.
WILLARD FRANCIS SCHADE, Cleveland, Ohio
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MCDALTON SHELBY, Austin, Tex.
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LENUEL FREEMAN WYLIE, Amarillo, Tex.
DANIEL HOUSTON YOUNG, Aurora, Minn.

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NORMAN FRANCIS DE SOUZA ARANHA, Nassau, Bahamas
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LUTHER ALTON BEALE, SR., Beaumont, Tex.
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ROY SOTOKU SHIMABUKURO, Honolulu, T.H.
SHELDON SPEVAK, Jacksonville, Fla.
WILLIAM EDWARD TEADERMAN, Toledo, Ohio
JOHN MICHAEL TEX, San Diego, Calif.
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RENE CESAR CABASSA VOUSTAD, San Juan, P.R.
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Applications for Junior Membership from ASCE Student Chapters are not listed.

Lockheed diversification in action...

At right: engineers and scientists work on some of the 46 major projects in progress at Lockheed

Operations Research discussion on continental defense

Operations Research openings

Electronics Specialists
Fire Control and Guidance Specialists
Aerodynamics Engineers
Physicists

Fatigue test on Super Constellation skin

Structural Engineering openings

Research Specialists
Structures Engineers
Stress Analysts
Weight Engineers

Why Lockheed offers Engineers better careers

There are three main reasons:

1. More opportunity for promotion
because there are more supervisory positions to be filled with 46 major projects underway, including 13 models of aircraft on assembly lines.

2. More career security
because Lockheed activities cover virtually the entire spectrum of aeronautical endeavor.

3. Life in Southern California
Scenic beauty, unmatched climate, wide recreational opportunities enhance life in the San Fernando Valley.

To Engineers who lack aircraft experience

Aircraft experience is not necessary to join Lockheed. It's your engineering training and experience that count. Lockheed trains you for aircraft engineering–at full pay.

Coupon below is for your convenience in requesting application form and more information on how Lockheed's expanding program can advance your career.

Design study on hydraulic requirements of new transport

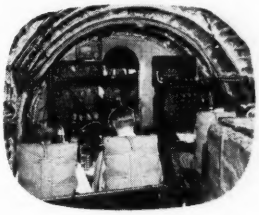
Design openings

Design positions are open at all levels in controls, electrical, hydraulics, mechanical, power plant and structures fields.

IBM 701 applied to jet transport flutter problem

Math. Analysis openings

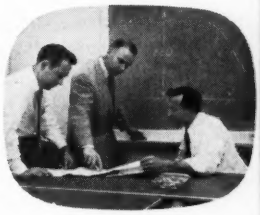
Math. Engineers
Math. Specialists
Math. Analysts



In-flight test on air speed performance

Flight Test Engineering openings

Flight Test Engineers
Flight Test Analysts
Instrumentation Engineers
Electrical Research Engineers



Aerodynamic meeting on high-speed fighter

Aerodynamics openings

Aerodynamics Engineers
Aerodynamicists
Dynamics Engineers
Wind Tunnel Test Engineers

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

First Batching Plant on Wheels

THE FIRST BATCHING PLANT ON WHEELS is a complete ready-to-operate unit. Known as the Noble-Mobile, it drives the highways within legal limits directly to the job site where shorter hauls result in greater capacity. The Noble-Mobile saves erection costs and requires no footing, crane or electrical wiring. Utilizing bulk cement, it has an output of 60-yd or more to truck mixers. Aggregates are charged with scooploader, conveyor or clamshell. **Noble Manufacturing Company, CE 12-118, 1860 Seventh St., Oakland 20, Calif.**

Submersible Booster Pump

A SUBMERSIBLE TYPE PUMP has been designed to meet the rigid requirements of industrial and municipal pump users. It provides invisible and noiseless operation, greater safety for both people and equipment, extra dependability in any weather, minimum space requirements, and virtually maintenance-free performance without need of lubrication. Embodying many improvements, the pump has an oversize shaft, and a mechanical shaft seal designed specifically for submerged service. The General Electric Motor has a larger oil reservoir. The pumps are factory assembled units so that the equipment is ready for use upon installation without adjustment.

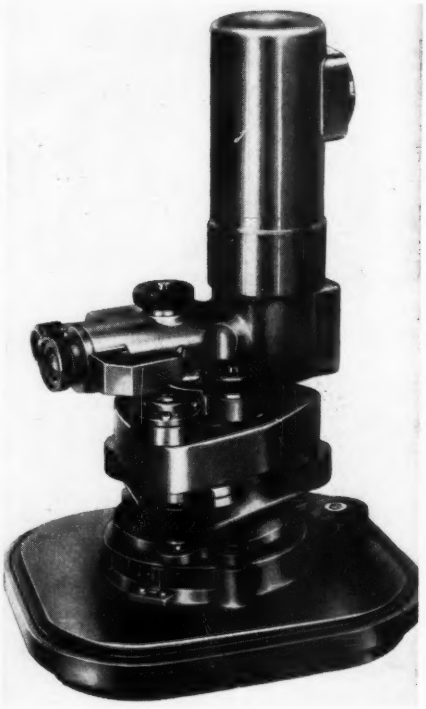
Standard models are available from 5 to 150-hp, with discharge head 50 to 500 ft and 100 to 4,000 CPM capacity. **Layne & Bowler Pump Company, CE 12-118, 2943 Vail Ave., Los Angeles 22, Calif.**

Rotary Compressor

AN ALL-NEW PORTABLE ROTARY COMPRESSOR, the Blue Brute 600, has been placed on the construction equipment market. A modernized unit with streamlined styling, new design and engineering features, it employs the most up-to-date engineering principles ever incorporated in any compressor of its kind. An easy-acting clutch allows operators to warm-up the engine before cutting the compressor. This results in less wear, quicker starts in cold weather, and simplified engine maintenance. The new Blue Brute's unique cylinder arrangement gravity-drains all oil and moisture during shutdowns. This feature assures protection of blades on cold starts. Engineers have simplified the design of the new compressor to a point where an unskilled mechanic can replace the rotor blade in a matter of minutes in the field. **Worthington Corporation, CE 12-118, Harrison, N. J.**

Automatic Level

WITH ITS OBJECTIVE LENS suspended by three wires, fine leveling of a new Italian-made instrument is automatic. All that's necessary is to roughly center the bubble in a bull's eye level. Gravity does the rest. Built in the style of a periscope, the upright portion of the level houses the suspended objective lens and a prism mounted above. The objective lens is held loosely in place by a flanged ring to prevent damage if the instrument is inverted while being moved about. A prismatic device projects an image of the bull's eye level into the field of view of the telescope eyepiece. This permits the operator to check the level of the instrument at the same time as he makes a reading from the rod or station. Distance readings are made in the orthodox manner. For more accurate readings of rod graduations, the instrument can be equipped with a micrometer screw. The standard instrument has a 24X telescope and is accurate to within 0.028 ft per mi. The instrument comes with a specially designed carrying case and adjustable leg tripod. **Filotecnica Salmoiraghi, CE 12-118, 41-14 24th St., Long Island City 1, N. Y.**



Filotechnic Transit-Level

Plastic Glass-Cloth

TO INSURE THE DIMENSIONAL ACCURACY of engineering drawings or reproductions, a tough, flexible, translucent Glass-Cloth is now being widely used. Plastic impregnated, the Cloth meets the urgent need for a convenient and economical drafting and reproduction medium. Its essential quality is its dimensional stability. Because it has a much lower coefficient of expansion than vellum or tracing cloth, Glass-Cloth has already replaced these materials in the aircraft industry, and many others. In addition, it is replacing the old method of producing stable drawings on metal sheets with costly photo equipment and many time-consuming hours. Glass-Cloth can be used for dimensionally stable originals, master duplicates, true-to-scale reproductions, as well as map reproductions and comparator charts. **Geo-Optic Company, Inc., CE 12-118, 170 Broadway, New York 38, N. Y.**

Sidebooms

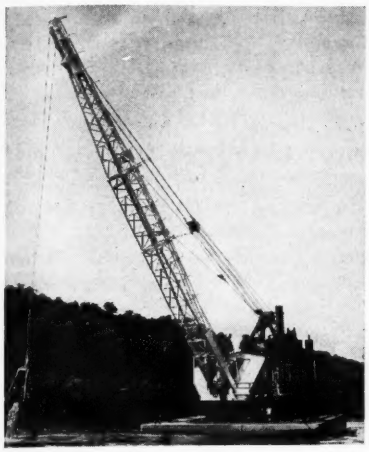
A COMPLETE LINE OF SIDEBOOMS matching International Harvester's new line of tractors TD-24 to TD-9 has just been announced. The complete series of sidebooms consist of six models from the PBI-9A to the PBI-241BH. Brand new features are the bottom hinged, hydraulic, extendable counter-weights operated and powered by a combination pump and valve tank unit. Lifting range is 110,000-lb capacity on the PBI-241BH at 4-ft radius. Also new is a change of the operating levers from vertical to horizontal position. This ties in with the operator comfort theme currently featured on the new IH tractors. **Superior Equipment Company, CE 12-118, Bucyrus, Ohio.**

Spark Resistant Demolition & Digging Tools

A NEW LINE OF PAVING BREAKER, DEMOLITION AND DIGGING TOOLS is on the market. These tools are for application in any plant handling such hazardous liquids as gasoline, naptha, benzine, lacquers, or flammable gases or dusts which could be ignited by a spark. Forged from a beryllium copper alloy, a material long known for its spark resisting purposes, they have a greater durability and longer life than that of their cast counterparts. Safety engineers can now play it safe, and at the same time get far greater tool life than ever before possible with this type of accessory. **Ingersoll-Rand Co., CE 12-118 11 Broadway, New York 4, N. Y.**

Derrick Boats

TWO NEW DERRICK BOATS of large capacity and unusual mechanical arrangement come equipped with an aluminum alloy boom with a working length up to 200 ft. This extreme reach permits setting sheetpiling 100 ft long and elim-



inates rehandling of material on the river bank. To provide the most effective boom length for any job, the boom was designed so it can be lengthened and shortened easily. A cable suspender system of boom fall sheaves was used to eliminate installation of additional cable for the longer booms.

The boats were designed with nearly square hulls to facilitate full rotation by the rig. Powered by steam, the two large rigs can handle heavy-duty clamshell buckets with capacities up to 5 cu yd. **Dravo Corporation, CE-12-119, Neville Island, Pittsburgh 25, Pa.**

Mighty Mover

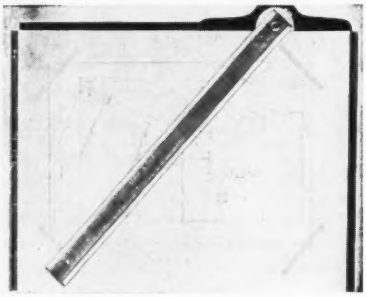
SOLVING THE PROBLEMS OF MOVING HEAVY MACHINERY WITH SAFETY, plus economy and speed is claimed for a revolutionary new dolly, the "Mighty Mover". Sold in sets of four, they bolt on to machinery after the equipment is raised with either a jack or a fork lift. Each dolly has two 4-in roller-bearing cast iron wheels, side and top plates of tough steel with a standard $\frac{1}{2}$-in threaded hole in the top swivel plate for bolting machinery. The set of four is guaranteed to carry loads to 90-tons, yet one man can easily move heavy machines in a fraction of the time formerly taken by a large crew using skids, wenches and cables. This virtually eliminates the possibilities of injuries. "Mighty Movers" are 9-in long, 5-in in width and height, and weigh 40-lbs. **The Acorn Company, CE 12-119, 1482 South Milwaukee St., Denver 10, Colo.**

EQUIPMENT MATERIALS and METHODS

(continued)

Drawing Board

DRAFTEZE IS A COMBINATION OF A UNIQUE DRAWING BOARD, so precision engineered as to make possible the use of a radical new instrument, a patented angular T square and a protractor, in one basic instrument. The complete unit is so inexpensive that it may be used as a second drawing board in the home or in the field. Made of the finest imported Finnish white birch, the board is covered



Radical new instrument

with a replaceable high-grade covering of laminated paper which is moisture resistant. Guide rails, which insure perfect angulation of the T square, are of tempered aluminum. The blade is straight grained white maple with clear lucite edge, dovetailed and bonded. **Weller Engineering Company, CE 12-120, 169 La Verne Ave., Long Beach 3, Calif.**

Sight Flow Indicator

A SIGHT FLOW INDICATOR which combines for the first time flow indication with positive check of back-flow has been introduced. The device has a self-aligning soft seat flapper which prevents back flow. Two $^1/_2$-in thick windows on opposite sides of the body fitting show clearly whether or not there is a flow. Approved by the U. S. Testing Laboratories for LPG service, it may be used for other applications requiring flow indication with positive check of back-flow. The rugged, through-bolted construction is suited for severe service in the process industries and permits cleaning the sight glasses without removing the unit from the pipe line.

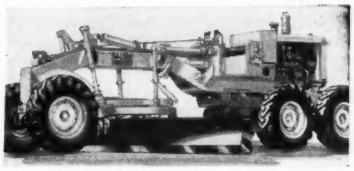
Standard sizes are for 2-in pipe, with an operating pressure rating of 250-lbs psi, and for $1^1/_2$-in pipe with a rating of 300 psi. Indicator bodies are of bronze or steel and gaskets of Thiokol. **Fischer & Porter Company, CE 12-120, 544 Jacksonville Rd., Hatboro, Pa.**

EQUIPMENT MATERIALS and METHODS

(continued)

Super Grader

A NEW MOTOR GRADER, designated as model T-700, is now in production as the world's biggest, heaviest and most productive motor grader. Equipped with a torque converter and power-shift transmission, it achieves amazing ease of operation and performance on the job. Designed and built new from the ground up, it has been work tested across the country in all kinds of weather and on all kinds of jobs. Every part of the grader is larger, more efficient, and specially designed to obtain tremendous push-power at the blade, where power means most. Engineered balance is emphasized in this new grader, with power, weight and blade pressure scientifically matched to move more material, in quicker cycles, with less operator fatigue. **The Galion Iron Works & Mfg. Co., CE 12-121, Galion, Ohio.**



Model T-700

Truck-Cranes

FIVE NEW TRUCK-CRANE MODELS, ranging from 12½ to 35-ton lifting capacity, are now being offered. Called Zephyrcranes because of their speed in moving from job to job, they offer contractors, industry and municipalities new highs in lifting and digging efficiency. All of these new models feature true power hydraulic control which permits the operator to control all working operations with a flick of the wrist. This feature alone, by reducing operator fatigue, increases output up to 25% or more. The Zephyrcranes deliver ample net horsepower or actual line pull for all operations. This greater net horsepower plus more live weight allows the machines to handle more work in less time with lower overall cost for maintenance and service.

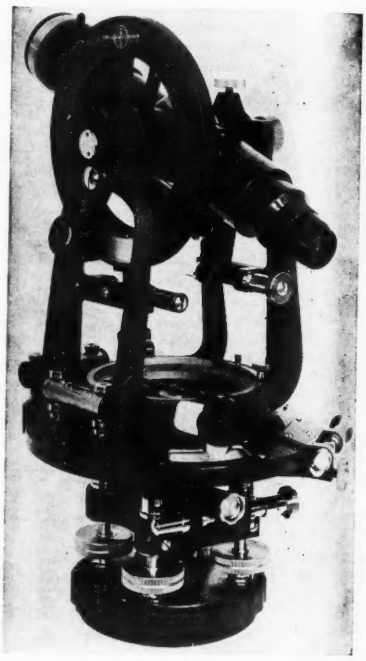
The smaller models are all-purpose lifting and digging machines, while the larger models are primarily erection rigs. All are mounted on specially designed carriers with full-floating walking beam rear axle supports that allow travel over uneven terrain. **Link-Belt Speeder Corporation, CE 12-121, Cedar Rapids, Iowa.**

EQUIPMENT MATERIALS and METHODS

(continued)

Survey Transit

A NEW FIVE 3/4-IN SURVEY TRANSIT with many improvements for quicker, more precise setting is announced. Included are rifle sights that bring the telescope on the target immediately, focusing knob through



Improved Transit

telescope axis that permits easy setting regardless of telescope position, improved graduated plate and other new features. Though inexpensive, this instrument is thoroughly dependable and accurate even when subjected to rugged use. **Uemco Optical Division, CE 12-122, 465 California St., San Francisco 4, Calif.**

Paving Breaker Safety Handle

A NEW SAFETY HANDLE WHICH THE MANUFACTURER CLAIMS IS THE FIRST OF ITS KIND, was developed as a result of many field requests for a safety handle to be used on tools in connection with demolition work where operators were injuring their hands when working close to walls or projecting masonry. The new safety device weighs less than 2 lbs. **Ingersoll-Rand Company, CE 12-122, 11 Broadway, New York 4, N. Y.**

EQUIPMENT MATERIALS and METHODS

(continued)

Electric Log Stacker

CONVERTING LOGS TO LUMBER for the current building boom will be a step easier in the future with a high-stepping Electric Log Stacker designed to mechanize today's primitive methods of loading and unloading logs. The machine is

Mechanical Stacker

capable of lifting a complete truckload of logs with one bite, thus making unloading as simple and sure as lifting a handful of pencils from a box. In operation, the machine approaches a 50,000-lb truckload of logs, inserts its 10-ft wedges beneath the load, then clamps two tremendous tusks over the top. After freeing the truck with a single bite, the Stacker turns and moves off to a storage or processing area where the operation is performed in reverse. **R. G. LeTourneau, Inc., CE 12-123, Longview, Texas.**

Big Guillotine Saw

A NEW LARGE CAPACITY POWER PIPE SAW, called the Big Guillotine, cuts cast iron on steel pipe up to 16-in. in diameter on the job in a matter of minutes. Based on the original Regular Guillotine Saw design, the Big Guillotine will cut 10-in. through 16-in. cast iron and steel pipe in a space only 32-in. wide. A double chain pipe vise clamps the saw to a pipe, ready to cut in a matter of seconds. A machined cast steel V saddle base assures a square cut or right angle to the pipe, which acts as the machine tool base. All this adds up to easier, faster and more accurate pipe cutting under all conditions. **The E. H. Wachs Company, CE 12-123, 1525 North Dayton St., Chicago 22, Ill.**

EQUIPMENT MATERIALS and METHODS

(continued)

Photoelectric Analyzer

THE MODEL III PHOTOELECTRIC ANALYZER, an instrument for automatically analyzing, recording and controlling chemical processes involving liquids, vapors or gases, is now on the market. Accurate automatic recording over many days, without auxiliary attendance, is possible with the analyzer because of its unique self-monitoring properties whereby it not only records or controls a process, but periodically and automatically checks and resets itself to compensate for smudge accumulation on cell windows. This "chemist in a box" serves equally well in problems involving monitoring and prevention of stream pollution. Many applications suggest themselves as a result of the instrument's acute sensitivity. Aside from liquid analysis, the instrument will automatically record quantities of such substances as mercury, ozone, sulfur dioxide, and many others. **Manufacturers Engineering & Equipment Corporation, CE 12-124, Hatboro, Pa.**

Cab-Over-Engine Motor Trucks

THREE NEW CAB-OVER-ENGINE MOTOR TRUCK MODELS designed for better load distribution and easier maneuverability, are the CO-180, with gross vehicle weight rating of 17,000 lbs; the CO-181, with GVW rating of 19,000 lbs.; and the CO-182, with GVW rating of 21,000 lbs. They are available in 99, 111, 123, 135, or 153-inch wheelbase.

The CO-180 series, which is equipped with the cab, frame, and front axle of the CO-190, is powered by the 137-horsepower engine. Transmission is five-speed; rear axle is the R-180 single-reduction. Brakes are hydraulic. The series also is available with factory engineered low-frame chassis as an attachment in 163 and 165-inch wheelbases. Water and oil can be easily serviced through a hinged opening in the top of the engine tunnel. The unique cab is counterbalanced to lift easily by hand.

Driver and serviceman safety are assured by the system of safety locks which secure the cab in place. The cab interior offers many driver convenience and comfort features. It is completely heat and sound insulated with a thick fiber glass type of lining pad on the engine tunnel. The driver's seat is of spring-type construction with a foam rubber topper and is adjustable fore and aft. In addition, the front edge of the seat is adjustable up and down, and the lower part of the back rest is adjustable to fit the driver's desired posture. **International Harvester Co., CE 12-124, 180 N. Michigan Ave., Chicago 1, Ill.**

FILMS AVAILABLE

"MILLIPORE FILTER"—A recently completed 20 minute, full color, 16-mm sound motion picture on the nature and properties of the significant new Millipore Filter and techniques of application in a wide range of analytical procedures is now available. The film demonstrates in a "step by step" manner the simple procedures of bacteriological water analysis. Various microbiological procedures with the filter are shown, as well as many other analytical techniques, including the monitoring of radioactive dust and other airborne hazards. **The Millipore Filter Corporation, CE-12-125, Watertown, Mass.**

"THE LONG STREET"—Dealing with modern super highway construction, this 16-mm motion picture in color is a professional production employing skilled actors. The story is built around the viewpoint of a small town druggist who resists the construction of a new super highway near his community. The film depicts how the modern contractor tackles the problem of rock removal, the operation of rock drills and air operated tools as well as other construction equipment. **Ingersoll-Rand Company, CE-12-125, Phillipsburg, N. J.**

"INDIAN PAINT"—A new film describes how iron ore was originally used by the Indians for war paint. In addition, seven other movies describe the production of steel, and important finished products. The manufacture of rails, wire rope, grader blades and reinforced concrete is pictured as well as the manufacture of products essential to the mining, agricultural and construction industries. These eight 16-mm sound color movies are all available on a free loan basis. **The Colorado Fuel and Iron Corporation, CE-12-125, 575 Madison Ave., New York, N. Y.**

"DIRECT LINE TO DECISION"—A system of electronic data processing machines can bring about a step-up in the flow of vital business information thus fulfilling the need for expanding management's decision-making capacity. The new 16-mm motion picture points out that this can be accomplished if executives receive accurate information on business operations more rapidly through such processing machines. Free of charge, this film can be obtained from any of IBM's 189 branch offices. **International Business Machines, CE-12-125, New York, N. Y.**

"SOIL-CEMENT FOR LOW-COST PAVING"—A 21-minute sound and color motion picture shows examples of soil-cement roads, streets, airports and parking areas in all parts of the United States. This 16-mm film includes an explanation of what soil-cement is, its properties, engineering characteristics, and a brief section on construction. Examples illustrate the material's proven record of durability and low cost. **Portland Cement Association, CE-12-125, 33 West Grand Avenue, Chicago 10, Ill.**

From the MANUFACTURERS

TON OF STEEL A MINUTE: Kaiser Engineers hold the exclusive licensing rights to the Oxygen Converter Process, a steel-making method new in this country. The process consists of introducing a stream of high-velocity oxygen to the surface of a charge of molten pig iron, iron ore and limestone, producing a high-quality steel at nearly a ton a minute... **EXCHANGE OF SHARES:** Syntron Company is now being operated as a subsidiary of the Link-Belt Company. Both are manufacturers of materials handling and feeder machinery... **NEW YORK'S BOWERY EXPANDS:** The first of four Enterprise diesel engines have been installed for the plant of New York City's enlarged Bowery Bay Pollution Control Project to be completed next year... **SEATTLE IS ON THE MAP:** A 3-dimensional, 6 by 7½-ft relief map of the Seattle area, from the Puget Sound to the crest of the Cascade Mountains, is helping officials of that area with their planning problems. Made by the Aero Service Corporation of Philadelphia, the plastic model emphasizes drainage patterns and land forms. It will be used for planning water-supply lines, power lines and other municipal projects... **WORLD RECORD IN WEIGHT-LIFTING BROKEN:** A new derrick recently lifted 800 tons in a single load off the Gulf of Mexico. Built by the American Hoist & Derrick Company, it was constructed for mounting off-shore drilling platforms to meet the needs of the petroleum industry... **ATLAS POWDER COMPANY:** Net earnings after taxes for the first nine months of 1955 were up 36% compared to last year's figures for the same period. The company manufactures explosives and chemicals... **GOVERNMENT APPROVAL:** Lewyt Air Conditioner Corporation has been given approval for their new consumer product, a built-in wall air conditioner, by the F. H. A. for private homes... **PRESIDENTIAL APPOINTMENT:** The Atomic Energy Commission has recently returned to its full five-man strength with the swearing-in of Harold S. Vance by Chairman Lewis L. Strauss. Mr. Vance was formerly Chairman of the Executive Committee of the Studebaker-Packard Corporation, and in the last year was President and Board Chairman of the Studebaker Corporation... **ELECTIONS AND APPOINTMENTS:** The American Road Builders' Association has named Burton F. Miller Deputy Executive Vice President... Frank C. Amsbary, Jr., President of the American Water Works Association, has assumed the position of Vice President and General Manager of the Long Island Water Corporation... Merritt-Chapman & Scott Corporation has elected Richard E. Mynatt as Vice President in charge of administration for the company's Construction Department...

PROCEEDINGS AVAILABLE

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817. **Flow into a Well by Electric and Membrane Analogy, by Chong-Hung Zee, Dean F. Peterson, and Robert O. Bock.** (EM) A study of radially symmetrical, unconfined flow to a well is reported. Using dimensional considerations, the discharge of such a system is related to the permeability of the aquifer and the geometric characteristics of the influence region. The electrical analogy for hydraulic flow is combined with the membrane analogy for the free surface. The experimental results and observations of other investigators are combined to obtain empirical relationships between the flow and the geometric variables.

818. **Thick Rectangular Plates on an Elastic Foundation, by Daniel Frederick.** (EM) Equations and solutions for the bending of thick rectangular plates resting on an elastic foundation are presented using the theory of plates developed by E. Reissner. Various types of fixity of edges involving three boundary conditions are considered. Two simple examples are included.

819. **Discussion of Proceedings Papers 692, 694, 695.** (EM)

820. **Physical and Chemical Control of Insects: Progress Report of the Sanitary Engineering Research Committee, Public Health Engineering Section.** (SA) The effectiveness of several types of screening and of residual insecticides incorporated in surface-protective coatings is reported, based on results of field and laboratory tests.

821. **The Effect of Nutrients upon the Rate of Stabilization of Spent Sulfite Liquor in Receiving Waters: Progress Report of the Sanitary Engineering Research Committee, Stream Pollution Section.** (SA) The results of a research project on the effect of sulfite waste liquor on the Willamette River in Oregon are presented in summarized form, critically considered, and evaluated constructively with a view toward engineering application.

822. **Discussion of Proceedings Papers 547, 685, 686, 687, 750, 779.** (SA)

823. **Rigid Culverts under High Overfills, by R. Robinson Rowe.** (HW) Adaptation of the earth arch to relieve culverts of part of their load has promised substantial economy. This practice has been justified by satisfactory performance. The paper summarizes progressive developments in design and reports the findings of a field review, including suggestions for further development of the practice.

824. **Using Consultants to Expand a Highway Program, by Rex M. Whitton.** (HW) The practice of the State of Missouri in using consultants to supplement the regular highway staff is described. The practice is more costly but recommended when the state's personnel or work capacity is limited. Examples are given.

825. **Determining Basic Wind Loads, by George F. Collins.** (ST) Wind records from meteorological towers are analyzed statistically to determine the variation of wind with elevation and the ratio of peak winds to average 5-min winds. A simple method is suggested for determining probable basic wind loads on structures in various geographical locations.

826. **Extending Streamflow Data, by W. B. Langbein and C. H. Hardison.** (HY) To provide more information for water projects, the recognized correlation between the discharges of streams, closely and similarly situated, may be applied. Correlations developed by graphic plots of monthly discharges generally confirm those based on daily data. Estimates obtained include the variability, group distribution, and other significant characteristics of an actual record. As demands for information mount, an increasing part of the stream-gaging program may be devoted to the operation of secondary or roving stations.

827. **Continuous Arches on Elastic Piers, by James Michalos and Darrel D. Girton.** (ST) A procedure involving successive corrections is presented for determining moments and thrusts in continuous arches. Exact influence lines are obtained by analyzing for only one position of a unit load in each span. The effects of pier dimensions on thrusts and moments are studied.

828. **Introduction to Semi-Rigid Determinate Polygonal Trusses, by Alexander H. Kenigsberg.** (ST) Novel semi-rigid pentagonal trusses are described, including the basic concepts, a general procedure for stress analysis, a numerical design procedure, and some distinguishing characteristics. In the appendices are given an alternate treatment

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of end panels, an introduction to shallow-type trusses, and a comparison of estimated weights for pentagonal and conventional trusses.

829. Analysis of Arches by Finite Differences, by Ephraim G. Hirsch and E. P. Popov. (ST) In flexible arches vertical and horizontal displacements of the rib due to imposed loading cause large increases in the bending moments computed on the basis of invariant arch geometry. The solution of two basic differential equations which relate the vertical and horizontal deflections of the rib to the internal forces by the finite difference method is discussed. Arches of any geometry, cross section, and conditions of loading may be analyzed by the proposed method. Moreover, it is rapid in application and may be readily mastered.

830. Load Test of a Diagonally Sheathed Timber Building, by J. Morley English and C. Franklin Knowlton, Jr. (ST) A description of tests of a diagonally sheathed timber building is presented. The building was designed in accordance with the Los Angeles County building code except that the end wall shears were in excess of the allowable for single diagonal sheathing and the length-depth ratio of the diagonally sheathed roof was in excess of that normally allowed. The load deflection characteristics are described, and the theoretical action of diaphragms is discussed.

831. Discussion of Proceedings Papers 541, 679, 680, 683, 684, 786. (ST)

832. Impact of Atomic Development on Growth and Planning of Urban Regions, by Park H. Martin. (CP) The result of the peacetime, controlled use of nuclear energy is heat to be transformed into electrical energy—a new basic source of energy with a familiar end product. Urban regional planning involves consideration of many factors: Industrial location, highways and streets, parking, parks and recreational facilities, and various municipal services. The new energy source does not seem to affect them as far as is presently known.

833. Local Government in the Atomic Age, by Harold F. Alderfer. (CP) What must be done to get cities ready for the atomic age, both in war and peace, are the things which will have to be done to preserve our cities. One of the most important things is governmental unity for the whole metropolitan area. Other necessities are to do away with blighted and slum areas and to streamline the administration of government services so that urban life can go on under any conditions.

834. Planning New Cities: Problems, Techniques and Solutions, by Albert Mayer. (CP) This paper points out opportunities that are being missed in the planning and development of large cities due to the fact that new technological developments are not being used creatively. The planner must keep the policy makers interested in planning problems. There must be continuity of planning, realistic progressive development, and citizen participation. Two cities are discussed as examples of the use of the recommended techniques.

835. Discussion of Proceedings Papers 508, 710. (CP)

836. Lunar-Cycle Measurement of Estuarine Flows, by Irvin M. Ingerson. (HY) This paper presents the novel "moving boat method" of making complete current-meter measurements of oscillating tidal flows as well as unique methods of computation yielding instantaneous values of measured freshwater outflows and values of saline interchange. The application of these methods is described; the computation methods result in reliably accurate evaluations of freshwater outflow.

837. Effect of Floods on Transportation by William H. Hobbs. (HY) The effect of floods on transportation is examined and evaluated as regards railroads, highways, pipelines, air fields, and navigable streams. Emphasis is placed on the effect on railroads. The loss of revenue, increased operating costs, and the cost of restoration due to flood damage on railroads are discussed. The advantages of flood protection for transportation and industries are illustrated.

838. Integrating the Equation of Gradually Varied Flow, by Ven Te Chow. (HY) A new method of integrating the equation of gradually varied flow in prismatic channels is presented, including a mathematical derivation, the use of an expanded Bakhmeteff's table, formulas for hydraulic exponents, and curves expediting determination of normal and critical depths. A numerical example and a list of many existing methods of direct integration are also given.

839. The 1951 Kansas City Flood, by Keith R. Barney. (HY) This review of the 1951 flood in the Kansas River Basin emphasizes the effect on industry in the flood plains. The flood caused nearly $500,000,000 damage; industrial buildings suffered in varying degrees, with deposition of silt a major factor affecting final "cleanup." Industry is rebuilding on old locations as the reservoir program is being speeded up.

840. Rainfall Depth—Duration Relationships, by Herbert M. Corn. (HY) The relationships of storm depths, duration, and patterns are considered, and a method of analysis is described which indicates that most short-time intense precipitations behave according to rigorous physical laws. Analyses of storms of varied depths, durations, and patterns are given.

841. Discussion of Proceedings Papers 534, 564, 668, 714. (HY)

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